



L PINBALL NOUN TABLES

P1000 THE FOLLOWING REFERS TO THE NOUN TABLES

R1001 COMPONENT CODE NUMBER INTERPRETATION

R1002 00000 1 COMPONENT
R1003 00001 2 COMPONENT
R1004 00010 3 COMPONENT
R1005 X1000 BIT4 = 1. DECIMAL ONLY
R1006 10000 BITS = 1. NO LOAD
R1007 END OF COMPONENT CODE NUMBERS
R1008 SP ROUTINE CODE NUMBER INTERPRETATION

R1009 00000 OCTAL ONLY
R1010 00001 STRAIGHT FRACTIONAL
R1011 00010 CDU DEGREES (XXX.XX)
R1012 00011 ARITHMETIC SP
R1013 00100 ARITH DP1 OUT(MULT BY 2EXP14 AT END) IN(STRAIGHT)
R1014 00101 ARITH DP2 OUT(STRAIGHT) IN(SL 7 AT END)
R1015 00110 Y OPTICS DEGREES (XX.XXX MAX 89.999) IN (STRAIGHT)
R1016 00111 ARITH DP3 OUT (SL 7 AT END)
R1017 01000 WHOLE HOURS IN R1, WHOLE MINUTES (MOD 60) IN R2,
SECONDS (MOD 60) 0XX.XX IN R3. *** ALARMS IF USED WITH OCTAL
R1018 01001 MINUTES (MOD 60) IN D1D2, D3 BLANK, SECONDS (MOD 60) IN D4D5
LIMITS TO 59859 IF MAG EXCEEDS THIS VALUE.
R1020 ALARMS IF USED WITH OCTAL ***** IN (ALARM)
R1021 ARITH DP4 OUT (STRAIGHT) IN (SL 3 AT END)
R1022 01010 ARITH1 SP OUT(MULT BY 2EXP14 AT END) IN(STRAIGHT)
R10221 01011 2 INTEGERS IN D1D2, D4D5, D3 BLANK.
R10222 01100 ALARMS IF USED WITH OCTAL ***** IN (ALARM)
R10223 END OF SP ROUTINE CODE NUMBERS
R1024 SP CONSTANT CODE NUMBER INTERPRETATION

R1025 00000 WHOLE USE ARITH
R1026 00000 DP TIME SEC (00X.XX SEC) USE ARITHDP1
R1027 00001 SPARE
R1028 00010 CDU DEGREES USE CDU DEGREES
R1029 00010 Y OPTICS DEGREES USE Y OPTICS DEGREES
R1030 00011 DP DEGREES (90) XX.XXX DEG USE ARITHDP3
R1031 00100 DP DEGREES (360) XXX.XX DEG USE ARITHDP4
R1032 00101 DEGREES (180) XXX.XX DEG USE ARITH
R1033 00110 WEIGHT2 (XXXXX. LBS) USE ARITH1
R1034 00111 POSITION5 (XXX.XX NAUTICAL MILES) USE ARITHDP3
R10351 POSITION4 (XXXXX. NAUTICAL MILES) USE ARITHDP3
R1037 01000
R10371



L PINBALL NOUN TABLES

USER'S PAGE NO. 2 E0 S4

R1038	01001	VELOCITY2 (XXXXX. PT/SEC)	USE ARITHDP4
R1039	01010	VELOCITY3 (XXXXX. PT/SEC)	USE ARITHDP3
R1040	01011	ELEVATION DEGREES(89.999MAX)	USE ARITH
R10401	01100	TRIM DEGREES (XXX.XX DEG)	USE ARITH
R10402	01101	INERTIA (XXXXXXB. SLUG PT PT)	USE ARITH
R104025	01101	THRUST MOMENT (XXXXXXB. PT LBS)	USE ARITH
R10403	01110	VELOCITY/2VS (XXXXX. PT/SEC)	USE ARITHDP4
R10404	01111	POSITION6 (XXXXX. NAUT MI)	USE ARITHDP3
R10405	10000	DRAW ACCELERATION (XXX.XX G)	USE ARITHDP2
R10406	10001	POSITION8 (XXXXX. NAUT MI)	USE ARITHDP3
R10407	10010	POSITION9 (XXX.XX NAUT MI)	USE ARITHDP4
R10408	10011	VELOCITY4 (XXXXX. PT/SEC)	USE ARITHDP2
R1041	END OF SF CONSTANT CODE NUMBERS		
R1042	FOR GREATER THAN SINGLE PRECISION SCALES, PUT ADDRESS OF MAJOR PART INTO		
R1043	NOUN TABLES.		
R1044	OCTAL LOADS PLACE +0 INTO MAJOR PART, DATA INTO MINOR PART.		
R1045	OCTAL DISPLAYS SHOW MINOR PART ONLY.		
R1046	TO GET AT BOTH MAJOR AND MINOR PARTS(IN OCTAL), USE NOUN 01.		
R1047	A NOUN MAY BE DECLARED 'DECIMAL ONLY' BY MAKING BIT4=1 OF ITS COMPONENT		
R1048	CODE NUMBER. IF THIS NOUN IS USED WITH ANY OCTAL DISPLAY VERB, OR IF		
R1049	DATA IS LOADED IN OCTAL, IT ALARMS.		
R1050	IN LOADING AN 'HOURS, MINUTES, SECONDS' NOUN, ALL 3 WORDS MUST BE		
R1051	LOADED, OR ALARM.		
R1052	ALARM IF AN ATTEMPT IS MADE TO LOAD 'SPLIT MINUTES/SECONDS' (MMSS).		
R1053	THIS IS USED FOR DISPLAY ONLY.		



L PINBALL NOUN TABLES

P1054 THE FOLLOWING ROUTINES ARE FOR READING THE NOUN TABLES AND THE SF TABLES
R1055 (WHICH ARE IN A SEPARATE BANK FROM THE REST OF PINBALL). THESE READING
R1056 ROUTINES ARE IN THE SAME BANK AS THE TABLES. THEY ARE CALLED BY DXCH Z.
R1057 LODNNTAB LOADS NNADTEM WITH THE NNADTAB ENTRY, NNTYPTM WITH THE
R1058 NNTYPTAB ENTRY. IF THE NOUN IS MIXED, IDAD1TEM IS LOADED WITH THE FIRST
R1059 IDADOTAB ENTRY, IDAD2TEM THE SECOND IDADOTAB ENTRY, IDAD3TEM THE THIRD
R1060 IDADOTAB ENTRY, RUTMXTM WITH THE RUTMTAB ENTRY. MIXBR IS SET FOR
R1061 MIXED OR NORMAL NOUN.

1200				06,3262		BANK 06	
120001	REP	1		42,2000		SETLOC PINBALL3	
120002				42,2062		BANK	
12001	REP	1				COUNT 42/NOUNS	
1201	REP	1		42,2062	52 152 0	LODNNTAB DXCH	IDAD2TEM
1202	REP	3	LAST	233	42,2063	51=002 1	INDEX NOUNREG
1203	REP	1			42,2064	3 2133 1	CAP NNADTAB
1204	REP	1			42,2065	54 146 0	TS NNADTEM
1205	REP	4	LAST	265	42,2066	51=002 1	INDEX NOUNREG
1206	REP	1			42,2067	3 2277 1	CAP NNTYPTAB
1207	REP	1			42,2070	54 147 1	TS NNTYPTM
1208	REP	5	LAST	265	42,2071	4 1002 0	CS NOUNREG
1209	REP	1			42,2072	6 4726 0	AD MIXCON
1210					42,2073	0 0006 1	EXTEND
1211	REP	1			42,2074	6 2100 1	RZMP LODMIXN
1212	REP	12	LAST	236	42,2075	3 4712 1	CAP ONE
1213	REP	1			42,2076	54 140 0	TS MIXBR
1214	REP	1			42,2077	0 2116 0	TC LODNLV
1215	REP	5	LAST	243	42,2100	3 4711 1	LODMIXN CAP TWO
1216	REP	2	LAST	265	42,2101	54 140 0	TS MIXBR
1217	REP	6	LAST	265	42,2102	51=002 1	INDEX NOUNREG
1218	REP	1			42,2103	3 2777 1	CAP RUTMXTAB -40D
1219	REP	1			42,2104	54 153 1	TS RUTMXTM
1220	REP	3	LAST	198	42,2105	3 4747 1	CAP LOW10
1221	REP	2	LAST	265	42,2106	7 0146 0	MASK NNADTEM
1222	REP	30	LAST	255	42,2107	54 002 1	TS Q
1223	REP	71	LAST	261	42,2110	50 000 1	INDEX A
1224	REP	1			42,2111	3 2563 0	CAP IDADOTAB
1225	REP	1			42,2112	54 150 1	TS IDAD1TEM
1226					42,2113	0 0006 1	EXTEND
1227	REP	31	LAST	265	42,2114	5 0002 0	INDEX Q
1228	REP	2	LAST	265	42,2115	3 2565 0	DCA IDADOTAB +1
1229	REP	2	LAST	265	42,2116	52 152 0	LODNLV DXCH IDAD2TEM
1230	REP	1			42,2117	52 006 0	DXCH Z
1231	REP	2	LAST	243	4726	MIXCON =	OCT50
R1232	GTSPOUT	LOADS	SPTMPT1, SPTMPT2	WITH THE DP	SFOUTAB	ENTRIES.	FIRST MIXED NOUN = 40. (DEC 40)

L PINBALL NOUN TABLES

USER'S PAGE NO. 4 E0 84

ZK(SPCQNUM) ARRIVES IN SPTEMP1.

ZK(SPCQNUM) ARRIVES IN SPTEMP1.

- NN NORMAL NOUNS
- 00 NOT IN USE
 - 01 SPECIFY MACHINE ADDRESS (FRACTIONAL)
 - 02 SPECIFY MACHINE ADDRESS (WHOLE)
 - 03 SPECIFY MACHINE ADDRESS (DEGREES)
 - 04 SPARE
 - 05 ANGULAR ERROR/DIFFERENCE
 - 06 OPTION CODE
 - 07 ECADR OF WORD TO BE MODIFIED
 - 08 ECADR OF BITS TO BE MODIFIED
 - 09 ECADR OF BITS TO BE MODIFIED
 - 10 ECADR OF BITS TO BE MODIFIED
 - 11 ECADR OF BITS TO BE MODIFIED
 - 12 ECADR OF BITS TO BE MODIFIED
 - 13 ECADR OF BITS TO BE MODIFIED
 - 14 ECADR OF BITS TO BE MODIFIED
 - 15 ECADR OF BITS TO BE MODIFIED
 - 16 ECADR OF BITS TO BE MODIFIED
 - 17 ECADR OF BITS TO BE MODIFIED
 - 18 ECADR OF BITS TO BE MODIFIED
 - 19 ECADR OF BITS TO BE MODIFIED
 - 20 ECADR OF BITS TO BE MODIFIED
 - 21 ECADR OF BITS TO BE MODIFIED
 - 22 ECADR OF BITS TO BE MODIFIED
 - 23 ECADR OF BITS TO BE MODIFIED
 - 24 ECADR OF BITS TO BE MODIFIED
 - 25 ECADR OF BITS TO BE MODIFIED
 - 26 ECADR OF BITS TO BE MODIFIED
 - 27 ECADR OF BITS TO BE MODIFIED

1233	REF	1		42,2120	52 124 1	GTSPOUT	DXCH	SPTEMP1
1234				42,2121	0 0006 1		EXTEND	
1235	REF	72	LAST	265	42,2122	5 0000 1	INDEX	A
1236	REF	1			42,2123	3 2514 0	DCA	SPOUTAB
1237	REF	2	LAST	266	42,2124	52 124 1	SPCOM	SPTEMP1
1238	REF	2	LAST	265	42,2125	52 006 0	DXCH	Z
R1239	GTSPIN LOADS SPTEMP1, SPTEMP2 WITH THE DP SPINTAB ENTRIES.							
1240	REF	3	LAST	266	42,2126	52 124 1	GTSPIN	SPTEMP1
1241					42,2127	0 0006 1	EXTEND	
1242	REF	73	LAST	266	42,2130	5 0000 1	INDEX	A
1243	REF	1			42,2131	3 2444 1	DCA	SPINTAB
1244	REF	1			42,2132	1 2124 0	TCP	SPCOM
A1400								
1401					42,2133	00000 1	NNADTAB	OCT
1402					42,2134	40000 0		OCT
1403					42,2135	40000 0		OCT
1404					42,2136	40000 0		OCT
1405					42,2137	00000 1		OCT
1406	REF	3	LAST	227	42,2140	01045 1	ECADR	DSPTM1
1407	REF	1			42,2141	01131 0	ECADR	OPTION1
1408	REF	1			42,2142	01003 0	ECADR	XREG
A14081								
A14062								
1409	REF	2	LAST	80	42,2143	01363 0	ECADR	ALMCADR
1410	REF	4	LAST	179	42,2144	00375 0	ECADR	FAILREG
1411					42,2145	77776 1	OCT	77776
1412					42,2146	00000 1	OCT	00000
1413	REF	1			42,2147	01051 1	ECADR	OPTIONX
A14131								
1414					42,2150	00000 1	OCT	00000
1415					42,2151	00000 1	OCT	0
1416					42,2152	77777 0	OCT	77777
1417	REF	2	LAST	74	42,2153	01051 1	ECADR	DSPTM1
1418	REF	3	LAST	238	42,2154	01333 0	ECADR	CPHIX
1419	REF	7	LAST	244	42,2155	01155 1	ECADR	THETAD
1420	REF	6	LAST	266	42,2156	01155 1	ECADR	THETAD
1421	REF	5	LAST	238	42,2157	00032 0	ECADR	CDUX
1422	REF	1			42,2160	00037 0	ECADR	PIPAX
1423	REF	9	LAST	266	42,2161	01155 1	ECADR	THETAD
1424					42,2162	00000 1	OCT	00000
1425	REF	3	LAST	240	42,2163	01051 1	ECADR	DSPTM2 +1
1426	REF	4	LAST	266	42,2164	01045 1	ECADR	DSPTM1
A14261								
1427	REF	5	LAST	266	42,2165	01045 1	ECADR	DSPTM1
1428	REF	4	LAST	257	42,2166	01362 1	ECADR	SMODE

L PINBALL NOUN TABLES

1429 REP 6 LAST 266 42,2167 00000 1
 1430 REP 7 LAST 267 42,2170 01045 1
 1431 REP 8 LAST 267 42,2171 01045 1
 1432 REP 8 LAST 267 42,2172 01045 1
 1433 REP 2 LAST 89 42,2173 02345 1
 1434 REP 15 LAST 213 42,2174 03412 0
 1435 REP 9 LAST 267 42,2175 01045 1
 1436 REP 3 LAST 212 42,2176 03660 1
 1437 REP 9 LAST 240 42,2177 00024 1
 1438 REP 3 LAST 171 42,2200 03662 0
 1439 REP 2 LAST 83 42,2201 01516 1
 1440 REP 1 42,2202 02640 1
 R14401 END OF NNADTAB FOR NORMAL NOUNS
 A14402 42,2203 64000 0
 1441
 A14411
 A14412 42,2204 02003 0
 1442
 A14421 42,2205 24006 1
 1443
 A14431
 A14432 42,2206 24011 1
 1444
 A14441
 A14442 42,2207 64014 0
 1445
 A14451
 A14452 42,2210 64017 0
 1446
 A14461
 A14462 42,2211 02022 0
 1447
 1446 42,2212 22025 0
 A14481 42,2213 22030 1
 1449
 A14491 42,2214 24033 1
 1450
 A14501
 A14502 42,2215 64036 0
 1451
 A14511
 A14512 42,2216 22041 1
 1452
 A14521 42,2217 00044 1
 1453
 1454 42,2220 24047 1
 A14541
 A14542

OCT 0
 ECADR DSPTM1
 ECADR DSPTM1
 ECADR DSPTM1
 ECADR -TPER
 ECADR TIG
 ECADR DSPTM1
 ECADR TTGO
 ECADR TIME2
 ECADR TTPI
 ECADR TET
 ECADR T3TOT4

OCT 64000

 OCT 02003

 OCT 24006

 OCT 24011

 OCT 64014

 OCT 64017

 OCT 02022
 OCT 22025
 OCT 22030
 OCT 24033

 OCT 64036

 OCT 22041
 OCT 00044
 OCT 24047

28 SPARE
 29 XSM LAUNCH AZIMUTH
 30 TARGET CODES
 31 TIME OF LANDING SITE (HRS,MIN,SEC)
 32 TIME TO PERIGEE (HRS,MIN,SEC)
 33 TIME OF IGNITION (HRS,MIN,SEC)
 34 TIME OF EVENT (HRS,MIN,SEC)
 35 TIME TO GO TO EVENT (HRS,MIN,SEC)
 36 TIME OF AGC CLOCK (HRS,MIN,SEC)
 37 TIG OF TPI (HRS,MIN,SEC)
 38 TIME OF STATE VECTOR
 39 DELTA TIME TO TRANSFER (HRS,MIN,SEC)

NN MIXED NOUNS
 40 TIME TO IGNITION/CUTOFF
 VG
 DELTA V (ACCUMULATED)
 41 TARGET AZIMUTH
 ELEVATION
 42 APOGEE
 PERIGEE
 DELTA V (REQUIRED)
 43 LATITUDE
 LONGITUDE
 ALTITUDE
 44 APOGEE
 PERIGEE
 TFF
 45 MARKS (VHP - OPTICS)
 TTI OF NEXT BURN
 MGA
 46 AUTOPILOT CONFIGURATION
 47 THIS VEHICLE WEIGHT
 OTHER VEHICLE WEIGHT
 48 PITCH TRIM
 YAW TRIM
 49 DELTA R
 DELTA V
 VHP OR OPTICS CODE
 50 SPLASH ERROR
 PERIGEE
 TFF
 51 S-BAND ANTENNA PITCH
 YAW
 52 CENTRAL ANGLE OF ACTIVE VEHICLE
 53 RANGE
 RANGE RATE
 PHI

L PINBALL NOUN TABLES

USER'S PAGE NO. 6 E0 S4

1455	42,2221	24052 0	OCT	24052
A14551				
A14552				
1456	42,2222	24055 1	OCT	24055
A14581				
A14582				
1459	42,2223	22060 1	OCT	22060
A14591				
1460	42,2224	20063 0	OCT	20063
1461	42,2225	24066 1	OCT	24066
A14611				
A14612				
1462	42,2226	24071 1	OCT	24071
1463	42,2227	24074 1	OCT	24074
A14631				
A14632				
1464	42,2230	24077 1	OCT	24077
A14641				
A14642				
1465	42,2231	24102 1	OCT	24102
A14651				
A14652				
1466	42,2232	64105 1	OCT	64105
A14661				
A14662				
1467	42,2233	24110 1	OCT	24110
A14671				
A14672				
1468	42,2234	24113 1	OCT	24113
A14681				
1470	42,2235	24116 1	OCT	24116
A14701				
A14702				
1471	42,2236	24121 0	OCT	24121
A14711				
A14712				
1472	42,2237	24124 0	OCT	24124
A14721				
A14722				
1473	42,2240	24127 0	OCT	24127
A14731				
A14732				
1474	42,2241	04132 0	OCT	04132
A14741				
A14742				
1475	42,2242	04135 1	OCT	04135
A14751				
A14752				
1476	42,2243	24140 1	OCT	24140
A14761				

54	RANGE
	RANGE RATE
	THETA
55	PERIGEE CODE
	ELEVATION ANGLE
	CENTRAL ANGLE
56	REENTRY ANGLE,
	DELTA V
57	DELTA R
58	PERIGEE ALT
	DELTA V TPI
	DELTA V TPF
59	DELTA VELOCITY LOS
60	GMAX
	VPRED
	GAMMA EI
61	IMPACT LATITUDE
	IMPACT LONGITUDE
	HEADS UP/DOWN
62	INERTIAL VEL MAG (VI)
	ALT RATE CHANGE (HDOT)
	ALT ABOVE PAD RADIUS (H)
63	RANGE 297,431 TO SPLASH (RTGO)
	PREDICTED INERT VEL (VIO)
	TIME TO GO TO 297,431 (TTE)
64	DRAW ACCELERATION
	INERTIAL VELOCITY (VI)
	RANGE TO SPLASH
65	SAMPLED AGC TIME (HRS,MIN,SEC)
	(FETCHED IN INTERRUPT)
66	COMMAND BANK ANGLE (BETA)
	CROSS RANGE ERROR
	DOWN RANGE ERROR
67	RANGE TO TARGET
	PRESENT LATITUDE
	PRESENT LONGITUDE
68	COMMAND BANK ANGLE (BETA)
	INERTIAL VELOCITY (VI)
	ALT RATE CHANGE (RDOT)
69	BETA
	DL
	VL
70	STAR CODE
	LANDMARK DATA
	HORIZON DATA
71	STAR CODE
	LANDMARK
	HORIZON
72	DELT ANG
	DELT ALT



L PINBALL NOUN TABLES

USER'S PAGE NO. 7 E0 S4

A14762					
1477	42,2244	00000 1	OCT	0	
1478	42,2245	00000 1	OCT	0	
1479	42,2246	00000 1	OCT	0	
1480	42,2247	00000 1	OCT	0	
1481	42,2250	00000 1	OCT	0	
1482	42,2251	00000 1	OCT	0	
1483	42,2252	00000 1	OCT	0	
1484	42,2253	64170 0	OCT	64170	
A14841					
A14842					
1485	42,2254	24173 1	OCT	24173	
1486	42,2255	00000 1	OCT	00000	
1487	42,2256	24201 1	OCT	24201	
1488	42,2257	24204 1	OCT	24204	
1489	42,2260	24207 1	OCT	24207	
1490	42,2261	24212 0	OCT	24212	
1491	42,2262	02215 0	OCT	02215	
A14911					
1492	42,2263	24220 1	OCT	24220	
1493	42,2264	24223 1	OCT	24223	
A14931					
A14932					
1494	42,2265	24226 1	OCT	24226	
A14941					
A14942					
1495	42,2266	02231 0	OCT	02231	
A14951					
1496	42,2267	02234 0	OCT	02234	
A14961					
1497	42,2270	04237 0	OCT	04237	
1498	42,2271	02242 1	OCT	02242	
A14981					
1499	42,2272	04245 0	OCT	04245	
1500	42,2273	04250 1	OCT	04250	
1501	42,2274	04253 1	OCT	04253	
1502	42,2275	04256 1	OCT	04256	
1503	42,2276	24261 1	OCT	24261	
A15031					
A15032					
R1504	END OF NNADTAB FOR MIXED NOUNS				
A1800					
1801	42,2277	00000 1	NNTYPTAB OCT	00000	
1802	42,2300	04040 1	OCT	04040	
1803	42,2301	04140 0	OCT	04140	
1804	42,2302	04102 0	OCT	04102	
1805	42,2303	00000 1	OCT	0	
1806	42,2304	00504 0	OCT	00504	

SEARCH OPTION

73 SPARE

74 SPARE

75 SPARE

76 SPARE

77 SPARE

78 SPARE

79 SPARE

80 TIME TO IGNITION/CUTOFF

VG

DELTA V (ACCUMULATED)

81 DELTA V (LV)

82 SPARE

83 DELTA V (BODY)

84 DELTA V (OTHER VEHICLE)

85 VG (BODY)

86 DELTA V (LV)

87 MARK DATA SHAFT

TRUNION

88 HALF UNIT SUN OR PLANET VECTOR

89 LANDMARK LATITUDE

LONGITUDE/2

ALTITUDE

90 Y

Y DOT

PSI

91 OCDU ANGLES SHAFT

TRUNION

92 NEW OPTICS ANGLES SHAFT

TRUNION

93 DELTA GYRO ANGLES

94 NEW OPTICS ANGLES SHAFT

TRUNION

95 PREFERRED ATTITUDE OCDU ANGLES

96 +X-AXIS ATTITUDE OCDU ANGLES

97 SYSTEM TEST INPUTS

98 SYSTEM TEST RESULTS

99 RMS IN POSITION

RMS IN VELOCITY

RMS OPTION

NN NORMAL NOUNS

00 NOT IN USE

01 3COMP FRACTIONAL

02 3COMP WHOLE

03 3COMP CDU DEGREES

04 SPARE

05 1COMP DPDEG(360)

L PINBALL NOUN TABLES

USER PAGE NO. 8 E0 S4

1807	42,2305	02000 0	OCT	02000
1808	42,2306	04000 0	OCT	04000
1809	42,2307	04000 0	OCT	04000
1810	42,2310	04000 0	OCT	04000
1811	42,2311	00000 1	OCT	00000
1812	42,2312	00000 1	OCT	00000
1813	42,2313	02000 0	OCT	02000
1814	42,2314	00000 1	OCT	00000
1815	42,2315	00000 1	OCT	0
1816	42,2318	00000 1	OCT	00000
1817	42,2317	24400 0	OCT	24400
1818	42,2320	04102 0	OCT	04102
1819	42,2321	04102 0	OCT	04102
1820	42,2322	04102 0	OCT	04102
1821	42,2323	04102 0	OCT	04102
1822	42,2324	04140 0	OCT	04140
1823	42,2325	04102 0	OCT	04102
1824	42,2326	00000 1	OCT	00000
1825	42,2327	24400 0	OCT	24400
1826	42,2330	04140 0	OCT	04140
1827	42,2331	04000 0	OCT	04000
1828	42,2332	00140 1	OCT	00140
1829	42,2333	00000 1	OCT	0
1830	42,2334	20102 0	OCT	20102
1831	42,2335	04140 0	OCT	04140
1832	42,2336	24400 0	OCT	24400
1833	42,2337	24400 0	OCT	24400
1834	42,2340	24400 0	OCT	24400
1835	42,2341	24400 0	OCT	24400
1836	42,2342	24400 0	OCT	24400
1837	42,2343	24400 0	OCT	24400
1838	42,2344	24400 0	OCT	24400
1839	42,2345	24400 0	OCT	24400
1840	42,2346	24400 0	OCT	24400
R18401	END OF NNTYPDAB FOR NORMAL NOUNS			
A18402				
1841	42,2347	24500 1	OCT	24500
A18411				
1842	42,2350	00542 1	OCT	00542
1843	42,2351	24410 1	OCT	24410
A18431				
1844	42,2352	20204 0	OCT	20204
A18441				
1845	42,2353	00410 1	OCT	00410
A18451				
1846	42,2354	10000 0	OCT	10000
A18461				
1847	42,2355	00000 1	OCT	00000

08	2COMP	OCTAL ONLY
07	3COMP	OCTAL ONLY
08	3COMP	OCTAL ONLY
09	3COMP	OCTAL ONLY
10	1COMP	OCTAL ONLY
11		SPARE
12	2COMP	OCTAL ONLY
13		SPARE
14	SPARE	
15	1COMP	OCTAL ONLY
16	3COMP	HMS (DEC ONLY)
17	3COMP	CDU DEG
18	3COMP	CDU DEG
19	3COMP	CDU DEG
20	3COMP	CDU DEGREES
21	3COMP	WHOLE
22	3COMP	CDU DEGREES
23		SPARE
24	3COMP	HMS (DEC ONLY)
25	3COMP	WHOLE
26	3COMP	OCTAL ONLY
27	1COMP	WHOLE
28		SPARE
29	1COMP	CDU DEG (DEC ONLY)
30	3COMP	WHOLE
31	3COMP	HMS (DEC ONLY)
32	3COMP	HMS (DEC ONLY)
33	3COMP	HMS (DEC ONLY)
34	3COMP	HMS (DEC ONLY)
35	3COMP	HMS (DEC ONLY)
36	3COMP	HMS (DEC ONLY)
37	3COMP	HMS (DEC ONLY)
38	3COMP	HMS (DEC ONLY)
39	3COMP	HMS (DEC ONLY)

NN MIXED NOUNS

40	3COMP	MIN/SEC, VEL3, VEL3 (NO LOAD, DEC ONLY)
41	2COMP	CDU DEG, ELEV DEG
42	3COMP	POS4, POS4, VEL3 (DEC ONLY)
43	3COMP	DPDEG(360), DPDEG(360), POS4 (DEC ONLY)
44	3COMP	POS4, POS4, MIN/SEC (NO LOAD, DEC ONLY)
45	3COMP	2INT, MIN/SEC, DPDEG(360) (NO LOAD, DEC ONLY)
46	2COMP	OCTAL ONLY FOR EACH



L PINBALL NOUN TABLES

USER'S PAGE NO. 9 E0 84

1848	42,2358	00308 1	OCT	00308	47 2COMP WEIGHT2 FOR EACH (DEC ONLY)
A18481	42,2357	00614 1	OCT	00614	48 2COMP TRIM DEG, TRIM DEG (DEC ONLY)
1849	42,2360	00510 0	OCT	00510	49 3COMP POS4, VEL3, WHOLE (DEC ONLY)
A18491	42,2361	00417 0	OCT	00417	50 3COMP POS8, POS4, MIN/SEC (NO LOAD, DEC ONLY)
1850	42,2362	00204 1	OCT	00204	51 2COMP DPDEG(380), DPDEG(380) (DEC ONLY)
A18501	42,2383	00004 0	OCT	00004	52 1COMP DPDEG(380)
1851	42,2384	10507 1	OCT	10507	53 3COMP POS5, VEL3, DPDEG(380) (DEC ONLY)
A18511	42,2385	10507 1	OCT	10507	54 3COMP POS6, VEL3, DPDEG(380) (DEC ONLY)
1852	42,2386	10200 1	OCT	10200	55 3COMP WHOLE, DPDEG(380), DPDEG(380) (DEC ONLY)
A18521	42,2387	00444 0	OCT	00444	56 2COMP DPDEG(380), VEL2 (DEC ONLY)
1853	42,2370	00010 0	OCT	00010	57 1COMP POS4 (DEC ONLY)
1854	42,2371	24510 0	OCT	24510	58 3COMP POS4, VEL3, VEL3 (DEC ONLY)
A18541	42,2372	24512 1	OCT	24512	59 3COMP VEL3 FOR EACH (DEC ONLY)
1855	42,2373	10440 0	OCT	10440	60 3COMP WHOLE, VEL2, DPDEG(380) (DEC ONLY)
A18551	42,2374	00204 1	OCT	00204	61 3COMP DPDEG(380), DPDEG(380), WHOLE (DEC ONLY)
1856	42,2375	20451 0	OCT	20451	62 3COMP VEL2, VEL2, POS4 (DEC ONLY)
A18561	42,2376	00457 1	OCT	00457	63 3COMP POS8, VEL2, MIN/SEC (NO LOAD, DEC ONLY)
1857	42,2377	36480 0	OCT	36480	64 3COMP DRAG ACCEL, VEL2, POS8 (DEC ONLY)
A18571	42,2400	00000 1	OCT	00000	65 3COMP HMS (DEC ONLY)
1858	42,2401	37044 0	OCT	37044	66 3COMP DPDEG(380), POS8, POS8 (DEC ONLY)
A18581	42,2402	10217 1	OCT	10217	67 3COMP POS6, DPDEG(380), DPDEG(380) (DEC ONLY)
1859	42,2403	34444 1	OCT	34444	68 3COMP DPDEG(380), VEL2, VEL/2VS (DEC ONLY)
A18591	42,2404	35004 0	OCT	35004	69 3COMP DPDEG(380), DRAG ACCEL, VEL/2VS (DEC ONLY)
1860	42,2405	00000 1	OCT	00000	70 3COMP OCTAL ONLY FOR EACH
A18601	42,2406	00000 1	OCT	0	71 3COMP OCTAL ONLY FOR EACH
1861	42,2407	00404 1	OCT	00404	72 3COMP DPDEG(380), POS4, WHOLE (DEC ONLY)
A18611	42,2410	00000 1	OCT	0	73 SPARE
1862	42,2411	00000 1	OCT	0	74 SPARE



L PINBALL NOUN TABLES

USER PAGE NO. 10 E0 84

1878	42,2412	00000 1	OCT	0
1879	42,2413	00000 1	OCT	0
1880	42,2414	00000 1	OCT	0
1881	42,2415	00000 1	OCT	0
1882	42,2416	00000 1	OCT	0
1883	42,2417	22440 1	OCT	22440
A18831				
1884	42,2420	24512 1	OCT	24512
A18841				
1885	42,2421	00000 1	OCT	00000
1886	42,2422	24512 1	OCT	24512
A18861				
1887	42,2423	24512 1	OCT	24512
A18871				
1888	42,2424	24512 1	OCT	24512
A18881				
1889	42,2425	22451 1	OCT	22451
A18891				
1890	42,2426	00102 1	OCT	00102
1891	42,2427	00000 1	OCT	0
A18912				
1892	42,2430	18143 0	OCT	18143
A18921				
1893	42,2431	10507 1	OCT	10507
A18931				
1894	42,2432	00102 1	OCT	00102
1895	42,2433	00102 1	OCT	00102
1896	42,2434	08143 1	OCT	08143
1897	42,2435	00102 1	OCT	00102
1898	42,2436	04102 0	OCT	04102
1899	42,2437	04102 0	OCT	04102
1900	42,2440	00000 1	OCT	00000
1901	42,2441	00000 1	OCT	00000
1902	42,2442	01162 0	OCT	01162
A19021				
R1903	END OF NNTYPTAB FOR MIXED NOUNS			
2200	42,2443	00006 1	SPINTAB OCT	00006
2201	42,2444	03240 1	OCT	03240
2202	42,2445	00000 1	OCT	00000
2203	42,2446	00000 1	OCT	00000
2204	42,2447	00000 1	OCT	00000
2205	42,2450	00000 1	OCT	00000
2206	42,2451	10707 0	OCT	10707
2207	42,2452	03435 0	OCT	03435
2208	42,2453	13070 1	OCT	13070
2209	42,2454	34345 1	OCT	34345
2210	42,2455	00005 1	OCT	00005
2211	42,2456	21616 0	OCT	21616

75	SPARE
76	SPARE
77	SPARE
78	SPARE
79	SPARE
80	3COMP MIN/SEC, VEL2, VEL2 (NO LOAD, DEC ONLY)
81	3COMP VEL3 FOR EACH (DEC ONLY)
82	SPARE
83	3COMP VEL3 FOR EACH (DEC ONLY)
84	3COMP VEL3 FOR EACH (DEC ONLY)
85	3COMP VEL3 FOR EACH (DEC ONLY)
86	3COMP VEL2 FOR EACH (DEC ONLY)
87	2COMP CDU DEG, Y OPTICS DEG
88	3COMP FRAC FOR EACH (DEC ONLY)
89	3COMP DPDEG(90), DPDEG(90), POS5 (DEC ONLY)
90	3COMP POS5, VEL3, DPDEG(360) (DEC ONLY)
91	2COMP CDU DEG, Y OPTICS DEG
92	2COMP CDU DEG, Y OPTICS DEG
93	3COMP DPDEG(90) FOR EACH
94	2COMP CDU DEG, Y OPTICS DEG
95	3COMP CDU DEG FOR EACH
96	3COMP CDU DEG FOR EACH
97	3COMP WHOLE FOR EACH
98	3COMP WHOLE, FRAC, WHOLE
99	3COMP POS9, VEL4, WHOLE (DEC ONLY)

WHOLE, DP TIME (SEC)

SPARE

CDU DEGREES, Y OPTICS DEGREES
(SPCONS IN DEGINSF, OPTDEGIN)DP DEGREES (90)
UPPED BY 1

DP DEGREES (360) (POINT BETWN BITS 11-12)

UPPED BY 1
DEGREES (180)



L PINBALL NOUN TABLES

2212	42,2457	26113 0	OCT	26113	WEIGHT2
2213	42,2460	31713 0	OCT	31713	
2214	42,2461	00070 0	OCT	00070	POSITION5
2215	42,2462	20460 1	OCT	20460	
2216	42,2463	01065 0	OCT	01065	POSITION4
2217	42,2464	05740 1	OCT	05740	
2218	42,2465	11414 0	OCT	11414	VELOCITY2 (POINT BETWN BITS 11-12)
2219	42,2466	31463 1	OCT	31463	
2220	42,2467	07475 0	OCT	07475	VELOCITY3
2221	42,2470	16051 1	OCT	16051	
2222	42,2471	00001 0	OCT	00001	ELEVATION DEGREES
2223	42,2472	03434 1	OCT	03434	
2224	42,2473	00002 0	OCT	00002	TRIM DEGREES
2225	42,2474	22245 1	OCT	22245	
2226	42,2475	00014 1	OCT	00014	INERTIA, THRUST MOMENT
2227	42,2476	35607 0	OCT	35607	
2228	42,2477	07606 0	OCT	07606	VELOCITY/2VS
2229	42,2500	06300 1	OCT	06300	
2230	42,2501	16631 1	OCT	16631	POSITION 6
2231	42,2502	11307 0	OCT	11307	
2232	42,2503	12000 1	OCT	12000	DRAG ACCELERATION (POINT BETWN BITS 7-8)
2233	42,2504	00000 1	OCT	00000	
2234	42,2505	27176 1	OCT	27176	POSITION 6
2235	42,2506	14235 0	OCT	14235	
2236	42,2507	16102 0	2DEC	1852 E3 B-22	POSITION9
2236	42,2510	14000 1			
2237	42,2511	07475 0	2DEC	30.46 B-7	VELOCITY4
2237	42,2512	16051 1			
A2290					END OF SPINTAB
2300	42,2513	05174 0	SPOUTAB OCT	05174	WHOLE, DP TIME (SEC)
2301	42,2514	13261 0	OCT	13261	
2302	42,2515	00000 1	OCT	00000	SPARE
2303	42,2516	00000 1	OCT	00000	
2304	42,2517	00000 1	OCT	00000	CDU DEGREES, Y OPTICS DEGREES
2305	42,2520	00000 1	OCT	00000	(SPCONS IN DEGOUTSP, OPTDEGOUT)
2306	42,2521	00714 0	OCT	00714	DP DEGREES (90) (POINT BETWN BITS 7-8)
2307	42,2522	31463 1	OCT	31463	
2308	42,2523	13412 1	OCT	13412	DP DEGREES (360)
2309	42,2524	07534 1	OCT	07534	
2310	42,2525	05605 1	OCT	05605	DEGREES (160)
2311	42,2526	03656 1	OCT	03656	
2312	42,2527	00001 0	OCT	00001	WEIGHT2
2313	42,2530	16170 0	OCT	16170	
2314	42,2531	00441 0	OCT	00441	POSITION5
2315	42,2532	34306 0	OCT	34306	
2316	42,2533	07176 0	OCT	07176	POSITION4
2317	42,2534	21603 1	OCT	21603	
2316	42,2535	15340 1	OCT	15340	VELOCITY2

L PINBALL NOUN TABLES

USER-S PAGE NO. 12 E0 S4

2319		42,2538	15340	1	OCT	15340
2320		42,2537	01031	1	OCT	01031
2321		42,2540	21032	0	OCT	21032
2322		42,2541	34631	1	OCT	34631
2323		42,2542	23146	0	OCT	23146
2324		42,2543	14340	0	OCT	14340
2325		42,2544	24145	1	OCT	24145
2326		42,2545	02363	0	OCT	02363
2327		42,2546	03721	0	OCT	03721
2328		42,2547	20373	1	OCT	20373
2329		42,2550	02122	1	OCT	02122
2330		42,2551	00424	0	OCT	00424
2331		42,2552	30446	1	OCT	30446
2332		42,2553	00831	0	OCT	00831
2333		42,2554	23148	0	OCT	23148
2334		42,2555	00280	0	OCT	00280
2335		42,2556	08213	1	OCT	08213
2336		42,2557	11038	1	2DEC	.283092873
2337		42,2560	06144	0	2DEC	.032808399
2337		42,2561	01031	1		
2337		42,2562	21032	0		
A2390						
A2400						

VELOCITY3 (POINT BETWN BITS 7-8)

ELEVATION DEGREES

TRIM DEGREES

INERTIA, THRUST MOMENT

VELOCITY/ZVS

POSITION 6 (POINT BETWN BITS 7-8)

DRAW ACCELERATION

POSITION 8

POSITION9

VELOCITY4

END OF SPQUTAB
NN SP CONSTANT

SP ROUTINE

2401	REF	4	LAST	267	42,2563	03660	1	IDADOTAB	ECADR	TTOGO	40 MIN/SEC	M/S
2402	REF	1			42,2564	03653	1		ECADR	VGDISP	40 VEL3	DP3
2403	REF	2	LAST	115	42,2565	03425	1		ECADR	DVTOTAL	40 VEL3	DP3
2404	REF	10	LAST	267	42,2566	01045	1		ECADR	DSPTM1	41 CDU DEG	CDU
2405	REF	11	LAST	274	42,2567	01046	1		ECADR	DSPTM1 +1	41 ELEV DEG	ARTH
2406					42,2570	00000	1		OCT	0	41 SPARE COMPONENT	
2407	REF	3	LAST	169	42,2571	02363	0		ECADR	HAPO	42 POS4	DP3
2408	REF	1			42,2572	02365	0		ECADR	HPER	42 POS4	DP3
2409	REF	2	LAST	274	42,2573	03653	1		ECADR	VGDISP	42 VEL3	DP3
2410	REF	4	LAST	176	42,2574	01103	1		ECADR	LAT	43 DPDEG(360)	DP4
2411	REF	3	LAST	176	42,2575	01105	1		ECADR	LONG	43 DPDEG(380)	DP4
2412	REF	3	LAST	178	42,2576	01107	0		ECADR	ALT	43 POS4	DP3
2413	REF	2	LAST	89	42,2577	02351	1		ECADR	HAPOX	44 POS4	DP3
2414	REF	2	LAST	89	42,2600	02353	0		ECADR	HPERX	44 POS4	DP3
2415	REF	2	LAST	89	42,2601	02343	1		ECADR	TFF	44 MIN/SEC	DP3
2416	REF	3	LAST	180	42,2602	01125	0		ECADR	VHFONT	45 2INT	M/S
2417	REF	5	LAST	274	42,2603	03660	1		ECADR	TTOGO	45 MIN/SEC	M/S
2418	REF	3	LAST	202	42,2604	03825	0		ECADR	AMGA	45 DPDEG(360)	DP4
2419	REF	13	LAST	248	42,2605	03088	1		ECADR	DAPDATR1	48 OCTAL ONLY	OCT
2420	REF	1			42,2606	03087	0		ECADR	DAPDATR2	48 OCTAL ONLY	OCT
2421					42,2607	00000	1		OCT	0	48 SPARE COMPONENT	
2422	REF	3	LAST	210	42,2610	03074	1		ECADR	CSMASS	47 WEIGHT2	ARTH1
2423	REF	4	LAST	173	42,2611	03073	0		ECADR	LEMMASS	47 WEIGHT2	ARTH1
2424					42,2612	00000	1		OCT	00000	47 SPARE COMPONENT	



L PINEBALL NOUN TABLES

USER'S PAGE NO. 13

E0 S4

2425	REP	11	LAST	255	42,2613	03025 0
2426	REP	1			42,2614	03026 0
2427					42,2615	00000 1
2428	REP	1			42,2616	03501 0
2429	REP	2	LAST	275	42,2617	03503 1
2430	REP	3	LAST	275	42,2620	03505 1
2431	REP	2	LAST	169	42,2621	02355 0
2432	REP	3	LAST	274	42,2622	02353 0
2433	REP	3	LAST	274	42,2623	02343 1
2434	REP	3	LAST	244	42,2624	02320 1
2435	REP	1			42,2625	02322 0
2436					42,2626	00000 1
2437	REP	2	LAST	91	42,2627	02632 1
2438					42,2630	00000 1
2439					42,2631	00000 1
2440	REP	6	LAST	171	42,2632	02320 1
2441	REP	2	LAST	68	42,2633	02322 0
2442	REP	3	LAST	171	42,2634	02324 0
2443	REP	7	LAST	275	42,2635	02320 1
2444	REP	3	LAST	275	42,2636	02322 0
2445	REP	4	LAST	275	42,2637	02324 0
2446	REP	1			42,2640	03645 0
2447	REP	4	LAST	171	42,2641	03743 1
2448	REP	3	LAST	171	42,2642	03753 0
2449	REP	2	LAST	125	42,2643	03633 1
2450	REP	2	LAST	125	42,2644	03631 0
2451					42,2645	00000 1
2452	REP	4	LAST	171	42,2646	02610 1
2453					42,2647	00000 1
2454					42,2650	00000 1
2455	REP	1			42,2651	02640 1
2456	REP	3	LAST	91	42,2652	02634 1
2457	REP	3	LAST	171	42,2653	02636 0
2458	REP	7	LAST	92	42,2654	02610 1
2459	REP	8	LAST	275	42,2655	02612 0
2460	REP	9	LAST	275	42,2656	02614 0
2461	REP	2	LAST	117	42,2657	03721 0
2462	REP	5	LAST	174	42,2660	03766 0
2463	REP	4	LAST	173	42,2661	03770 1
2464	REP	4	LAST	173	42,2662	03400 0
2465	REP	2	LAST	115	42,2663	03402 1
2466	REP	2	LAST	110	42,2664	03326 0
2467	REP	2	LAST	117	42,2665	03722 0
2468	REP	1			42,2666	03736 0
2469	REP	2	LAST	116	42,2667	03734 1
2470	REP	4	LAST	116	42,2670	03713 1
2471	REP	4	LAST	174	42,2671	03724 0
2472	REP	4	LAST	174	42,2672	03726 1
2473	REP	2	LAST	116	42,2673	03637 0
2474	REP	3	LAST	275	42,2674	03722 0

ECADR	PACTOFF	46	TRIM DEG	ARTH
ECADR	YACTOFF	46	TRIM DEG	ARTH
OCT	00000	46	SPARE COMPONENT	
ECADR	N4GDISP	49	POS4	DP3
ECADR	N4GDISP +2	49	VEL3	DP3
ECADR	N4GDISP +4	49	WHOLE	ARTH
ECADR	RSP-RREC	50	POS6	DP3
ECADR	HPERX	50	POS4	DP3
ECADR	TFF	50	MIN/SEC	M/S
ECADR	RHOSB	51	DPDEG(360)	
ECADR	GAMMASB	51	DPDEG(360)	DP4
OCT	0	51	SPARE COMPONENT	
ECADR	ACTCENT	52	DPDEG(360)	DP4
OCT	00000	52	SPARE COMPONENT	
OCT	00000	52	SPARE COMPONENT	
ECADR	RANGE	53	POS5	DP1
ECADR	RRATE	53	VEL3	DP3
ECADR	RTHETA	53	DPDEG(360)	DP4
ECADR	RANGE	54	POS5	DP1
ECADR	RRATE	54	VEL3	DP3
ECADR	RTHETA	54	DPDEG(360)	DP4
ECADR	NN1	55	WHOLE	ARTH
ECADR	ELEV	55	DPDEG(360)	DP4
ECADR	CENTANG	55	DPDEG(360)	DP4
ECADR	RTEGAM2D	56	DPDEG(360)	DP4
ECADR	RTEGMD	56	VEL2	DP4
OCT	0	56	SPARE COMPONENT	
ECADR	DELTAR	57	POS4	DP3
OCT	0	57	SPARE COMPONENT	
OCT	0	57	SPARE COMPONENT	
ECADR	POSTTPI	58	POS4	DP3
ECADR	DELVTPI	58	VEL3	DP3
ECADR	DELVTPI	58	VEL3	DP3
ECADR	DVLOS	59	VEL3	DP3
ECADR	DVLOS +2	59	VEL3	DP3
ECADR	DVLOS +4	59	VEL3	DP3
ECADR	GMAX	60	WHOLE	ARTH
ECADR	VPRD	60	VEL2	DP4
ECADR	GAMMAEI	60	DPDEG(360)	DP4
ECADR	LAT(SPL)	61	DPDEG(360)	DP4
ECADR	LNG(SPL)	61	DPDEG(360)	DP4
ECADR	HEADSUP	61	WHOLE	ARTH
ECADR	VMAGI	62	VEL2	DP4
ECADR	HDOT	62	VEL2	DP4
ECADR	ALTI	62	POS4	DP3
ECADR	RTGO	63	POS6	DP3
ECADR	VIO	63	VEL2	DP4
ECADR	TTE	63	MIN/SEC	M/S
ECADR	D	64	DRAG ACCEL	DP2
ECADR	VMAGI	64	VEL2	DP4

USER'S PAGE NO. 14 E0 S4

ECADR	RIGON64
ECADR	SAMPTIME
ECADR	SAMPTIME
ECADR	SAMPTIME
ECADR	ROLLC
ECADR	XTCGRIR
ECADR	DRENGERR
ECADR	RIGON87
ECADR	LAT
ECADR	LONG
ECADR	ROLLC
ECADR	NAGI
ECADR	FDOT
ECADR	ROLLC
ECADR	Q7
ECADR	VL
ECADR	STARCODE
ECADR	LANDMARK
ECADR	HORIZON
ECADR	STARCODE
ECADR	LANDMARK
ECADR	HORIZON
ECADR	TETZERO
ECADR	DELHTE
ECADR	OPTION2
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
OCT	0
ECADR	TTGO
ECADR	VODISP
ECADR	DVOTAL
ECADR	DEMLVC

64	POS6	DP3
85	HMS (MIXED ONLY TO KEEP CODE 85)	HMS
65	HMS	HMS
65	HMS	HMS
68	DPDEG(360)	DP4
68	POS8	DP3
68	POS6	DP3
67	POS6	DP4
67	DPDEG(380)	DP4
67	DPDEG(360)	DP4
68	DPDEG(360)	DP4
68	VEL2	DP4
68	VEL/2VS	DP4
69	DPDEG(380)	DP4
69	DRAG ACCEL	DP2
69	VEL/2VS	DP4
70	OCTAL ONLY	OCT
70	OCTAL ONLY	OCT
70	OCTAL ONLY	OCT
71	OCTAL ONLY	OCT
71	OCTAL ONLY	OCT
71	OCTAL ONLY	OCT
72	DPDEG(360)	DP4
72	POS4	DP3
72	WHOLE	ARTH
73	SPARE	
73	SPARE	
73	SPARE	
74	SPARE	
74	SPARE	
74	SPARE	
75	SPARE	
75	SPARE	
75	SPARE	
76	SPARE	
76	SPARE	
76	SPARE	
77	SPARE	
77	SPARE	
77	SPARE	
78	SPARE	
78	SPARE	
78	SPARE	
79	SPARE	
79	SPARE	
79	SPARE	
80	MIN/SEC	M/S
80	VEL2	DP4
80	VEL2	DP4
81	VEL3	DP3



L PINBALL NOUN TABLES

USER'S PAGE NO. 15 E0 S4

2525	REF	2	LAST	278	42,2757	03408 0
2526	REF	3	LAST	277	42,2760	03410 1
2527					42,2761	00000 1
2528					42,2762	00000 1
2529					42,2763	00000 1
2530	REF	3	LAST	208	42,2764	03874 1
2531	REF	4	LAST	277	42,2765	03876 0
2532	REF	5	LAST	277	42,2766	03700 0
2533	REF	1			42,2767	03537 0
2534	REF	2	LAST	277	42,2770	03541 1
2535	REF	3	LAST	277	42,2771	03543 0
2536	REF	3	LAST	122	42,2772	03884 0
2537	REF	4	LAST	277	42,2773	03886 1
2538	REF	5	LAST	277	42,2774	03870 0
2539	REF	4	LAST	277	42,2775	03404 1
2540	REF	5	LAST	277	42,2776	03408 0
2541	REF	6	LAST	277	42,2777	03410 1
2542	REF	16	LAST	252	42,3000	03730 0
2543	REF	17	LAST	277	42,3001	03732 1
2544					42,3002	00000 1
2545	REF	3	LAST	209	42,3003	02765 1
2546	REF	4	LAST	277	42,3004	02767 0
2547	REF	5	LAST	277	42,3005	02771 1
2548	REF	1			42,3006	01103 1
2549	REF	2	LAST	89	42,3007	02357 1
2550	REF	2	LAST	89	42,3010	02361 1
2551	REF	8	LAST	275	42,3011	02320 1
2552	REF	4	LAST	275	42,3012	02322 0
2553	REF	5	LAST	275	42,3013	02324 0
2554	REF	7	LAST	219	42,3014	00038 1
2555	REF	6	LAST	219	42,3015	00035 1
2556					42,3016	00000 1
2557	REF	3	LAST	238	42,3017	02773 0
2558	REF	3	LAST	238	42,3020	02775 0
2559					42,3021	00000 1
2560	REF	6	LAST	237	42,3022	02757 0
2561	REF	7	LAST	277	42,3023	02761 0
2562	REF	8	LAST	277	42,3024	02783 1
2563	REF	18	LAST	277	42,3025	03730 0
2564	REF	19	LAST	277	42,3026	03732 1
2565					42,3027	00000 1
2566	REF	2	LAST	124	42,3030	03722 0
2567	REF	3	LAST	277	42,3031	03723 1
2568	REF	4	LAST	277	42,3032	03724 0
2569	REF	4	LAST	288	42,3033	01333 0
2570	REF	5	LAST	277	42,3034	01334 1
2571	REF	6	LAST	277	42,3035	01335 0
2572	REF	12	LAST	274	42,3036	01045 1
2573	REF	13	LAST	277	42,3037	01046 1
2574	REF	14	LAST	277	42,3040	01047 0

ECADR	DELVLVC	+2	81	VEL3	DP3
ECADR	DELVLVC	+4	81	VEL3	DP3
OCT	00000		82	SPARE	
OCT	00000		82	SPARE	
OCT	00000		82	SPARE	
ECADR	DELVIMU		83	VEL3	DP3
ECADR	DELVIMU	+2	83	VEL3	DP3
ECADR	DELVIMU	+4	83	VEL3	DP3
ECADR	DELVOV		84	VEL3	DP3
ECADR	DELVOV	+2	84	VEL3	DP3
ECADR	DELVOV	+4	84	VEL3	DP3
ECADR	VGBODY		85	VEL3	DP3
ECADR	VGBODY	+2	85	VEL3	DP3
ECADR	VGBODY	+4	85	VEL3	DP3
ECADR	DELVLVC		88	VEL2	DP4
ECADR	DELVLVC	+2	88	VEL2	DP4
ECADR	DELVLVC	+4	88	VEL2	DP4
ECADR	MRKBUP1	+3	87	CDU DEG	CDU
ECADR	MRKBUP1	+5	87	Y OPTICS DEG	YOPT
OCT	0		87	SPARE COMPONENT	
ECADR	STAR		88	FRAC	FRAC
ECADR	STAR	+2	88	FRAC	FRAC
ECADR	STAR	+4	88	FRAC	FRAC
ECADR	LANDLAT		89	DPDEG(90)	DP3
ECADR	LANDLONG		89	DPDEG(90)	DP3
ECADR	LANDALT		89	POSS	DP1
ECADR	RANGE		90	POSS	DP1
ECADR	RRATE		90	VEL3	DP3
ECADR	RTHETA		90	DPDEG(380)	DP4
ECADR	CDUS		91	CDU DEG	CDU
ECADR	CDUT		91	Y OPTICS DEG	YOPT
OCT	0		91	SPARE COMPONENT	
ECADR	SAC		92	CDU DEG	CDU
ECADR	PAC		92	Y OPTICS DEG	YOPT
OCT	0		92	SPARE COMPONENT	
ECADR	OGC		93	DPDEG(90)	DP3
ECADR	OGC	+2	93	DPDEG(90)	DP3
ECADR	OGC	+4	93	DPDEG(90)	DP3
ECADR	MRKBUP1	+3	94	CDU DEG	CDU
ECADR	MRKBUP1	+5	94	Y OPTICS DEG	YOPT
OCT	0		94	SPARE	
ECADR	PRAXIS		95	CDU DEG	CDU
ECADR	PRAXIS	+1	95	CDU DEG	CDU
ECADR	PRAXIS	+2	95	CDU DEG	CDU
ECADR	CPHIX		98	CDU DEG	CDU
ECADR	CPHIX	+1	98	CDU DEG	CDU
ECADR	CPHIX	+2	98	CDU DEG	CDU
ECADR	DSPTM1		97	WHOLE	ARTH
ECADR	DSPTM1	+1	97	WHOLE	ARTH
ECADR	DSPTM1	+2	97	WHOLE	ARTH

L PINBALL NOUN TABLES

USER=5 PAGE NO. 16 E0 S4

2575 REF 4 LAST 268 42,3041 01050 0
 2576 REF 5 LAST 278 42,3042 01051 1
 2577 REF 6 LAST 278 42,3043 01052 1
 2578 REF 1 42,3044 02320 1
 2579 REF 1 42,3045 02322 0
 2580 REF 1 42,3046 02324 0
 R2600 END OF IDADDTAB
 A2800

ECADR DSPTM2
 ECADR DSPTM2 +1
 ECADR DSPTM2 +2
 ECADR WWPOS
 ECADR WWVEL
 ECADR WWOPT

96 WHOLE
 98 FRAC
 98 WHOLE
 98 POS9
 99 VEL4
 99 WHOLE

ARTH
 FRAC
 ARTH
 DP4
 DP2
 ARTH

NN SP ROUTINES

2801 42,3047 18351 1 RJTMXTAB OCT 18351
 2802 42,3050 00142 0 OCT 00142
 2803 42,3051 18347 0 OCT 18347
 2804 42,3052 18512 0 OCT 18512
 2805 42,3053 22347 1 OCT 22347
 2806 42,3054 24454 1 OCT 24454
 2807 42,3055 00000 1 OCT 00000
 2808 42,3056 00553 1 OCT 00553
 2809 42,3057 00143 1 OCT 00143
 2810 42,3060 08347 1 OCT 08347
 2811 42,3061 22347 1 OCT 22347
 2812 42,3082 00512 1 OCT 00512
 2813 42,3083 00012 1 OCT 00012
 2814 42,3084 24344 1 OCT 24344
 2815 42,3085 24344 1 OCT 24344
 2816 42,3088 24503 1 OCT 24503
 2817 42,3087 00512 1 OCT 00512
 2818 42,3070 00007 0 OCT 00007
 2819 42,3071 18347 0 OCT 18347
 2820 42,3072 18347 0 OCT 18347
 2821 42,3073 24503 1 OCT 24503
 2822 42,3074 08512 1 OCT 08512
 2823 42,3075 18512 0 OCT 18512
 2824 42,3076 22507 0 OCT 22507
 2825 42,3077 18505 0 OCT 18505
 2826 42,3100 20410 0 OCT 20410
 2827 42,3101 18352 1 OCT 18352
 2828 42,3102 24507 0 OCT 24507
 2829 42,3103 24512 1 OCT 24512
 2830 42,3104 24252 1 OCT 24252
 2831 42,3105 00000 1 OCT 00000
 2832 42,3108 00000 1 OCT 0
 2833 42,3107 08352 0 OCT 08352
 2834 42,3110 00000 1 OCT 0
 2835 42,3111 00000 1 OCT 0
 2836 42,3112 00000 1 OCT 0
 2837 42,3113 00000 1 OCT 0
 2838 42,3114 00000 1 OCT 0
 2839 42,3115 00000 1 OCT 0

40 M/S, DP3, DP3
 41 CDU, ARTH
 42 DP3, DP3, DP3
 43 DP4, DP4, DP3
 44 DP3, DP3, M/S
 45 2INT, M/S, DP4
 48 OCT, OCT
 47 ARITH1, ARITH1
 46 ARTH, ARTH
 49 DP3, DP3, ARTH
 50 DP3, DP3, M/S
 51 DP4, DP4
 52 DP4
 53 DP1, DP3, DP4
 54 DP1, DP3, DP4
 55 ARTH, DP4, DP4
 58 DP4, DP4
 57 DP3
 58 DP3, DP3, DP3
 59 DP3, DP3, DP3
 60 ARTH, DP4, DP4
 61 DP4, DP4, ARTH
 62 DP4, DP4, DP3
 63 DP3, DP4, M/S
 64 DP2, DP4, DP3
 65 HMS, HMS, HMS
 66 DP4, DP3, DP3
 67 DP3, DP4, DP4
 68 DP4, DP4, DP4
 69 DP4, DP2, DP4
 70 OCT, OCT, OCT
 71 OCT, OCT, OCT
 72 DP4, DP3, ARTH
 73 SPARE
 74 SPARE
 75 SPARE
 76 SPARE
 77 SPARE
 78 SPARE



L PINBALL NOUN TABLES

USBRAS PAGE NO. 17

E0 S4

2840	42,3116	00000 1	OCT	0	79 SPARE
2841	42,3117	24511 1	OCT	24511	80 M/S, DP4, DP4
2842	42,3120	18347 0	OCT	18347	81 DP3, DP3, DP3
2843	42,3121	00000 1	OCT	00000	82 SPARE
2844	42,3122	18347 0	OCT	18347	83 DP3, DP3, DP3
2845	42,3123	18347 0	OCT	16347	84 DP3, DP3, DP3
2846	42,3124	18347 0	OCT	16347	85 DP3, DP3, DP3
2847	42,3125	24512 1	OCT	24512	88 DP4, DP4, DP4
2848	42,3128	00302 0	OCT	00302	87 CDU, YOFT
2849	42,3127	02041 0	OCT	02041	88 FRAC FOR EACH
2850	42,3130	10347 0	OCT	10347	89 DP3, DP3, DP1
2851	42,3131	24344 1	OCT	24344	90 DP1, DP3, DP4
2852	42,3132	00302 0	OCT	00302	91 CDU, YOFT
2853	42,3133	00302 0	OCT	00302	92 CDU, YOFT
2854	42,3134	18347 0	OCT	18347	93 DP3, DP3, DP3
2855	42,3135	00302 0	OCT	00302	94 CDU, YOFT
2858	42,3138	04102 0	OCT	04102	95 CDU, CDU, CDU
2857	42,3137	04102 0	OCT	04102	98 CDU, CDU, CDU
2858	42,3140	06143 1	OCT	06143	97 ARTH, ARTH, ARTH
2859	42,3141	08043 0	OCT	08043	98 ARTH, FRAC, ARTH
2860	42,3142	06252 1	OCT	06252	99 DP4, DP2, ARTH
R2870	END OF RUTMTAB				
2871	REP	2 LAST	32	30,2000	SRANK= LOWSUPER



L CSM GEOMETRY

USER=8 PAGE NO. 1 E0 Sr

0001 22,2000 BANK 22
0002 REF 1 23,2000 SETLOC COMGEOM1
0003 23,2000 BANK

R0004 THIS ROUTINE TAKES THE SHAFT AND TRUNNION ANGLES AS READ BY THE CM OPTICAL SYSTEM AND CONVERTS THEM INTO A UNIT
R0006 VECTOR REFERENCED TO THE NAVIGATION BASE COORDINATE SYSTEM AND COINCIDENT WITH THE SEXTANT LINE OF SIGHT.

R0008 THE INPUTS ARE 1) THE SEXTANT SHAFT AND TRUNNION ANGLES ARE STORED SP IN LOCATIONS 3 AND 5 RESPECTIVELY OF THE
R0010 MARK VAC AREA. 2) THE COMPLEMENT OF THE BASE ADDRESS OF THE MARK VAC AREA IS STORED SP AT LOCATION X1 OF YOUR
R0012 JOB VAC AREA.

R0013 THE OUTPUT IS A HALF-UNIT VECTOR IN NAVIGATION BASE COORDINATES AND STORED AT LOCATION 32D OF THE VAC AREA. THE
R0015 OUTPUT IS ALSO AVAILABLE AT MPAC.

0016 REF 1 COUNT 23/GEOM

0017		23,2000	47133 0	SXTNB	SLOAD* RTB	PUSHDOWN 00,02,04,(17D-19D),32D-36D
0018		23,2001	00008 1		5,1	TRUNNION = TA
0019	REF 1	23,2002	45510 1		CDULOGIC	
0020		23,2003	41434 1	RTB	PUSH	
0021	REF 1	23,2004	46027 0		SXTLOGIC	
0022		23,2005	72558 1	SIN	SL1	
0023		23,2006	86808 1	PUSH	SLOAD*	PD2 = SIN(TA)
0024		23,2007	00004 0		3,1	SHAFT = SA
0025		23,2010	41434 1	RTB	PUSH	PD4 = SA
0026	REF 2 LAST 280	23,2011	45510 1		CDULOGIC	
0027		23,2012	41346 0	COS	DMP	
0028		23,2013	00003 1		2	
0029	REF 1	23,2014	14041 1	STOOL	STARM	COS(SA)SIN(TA)
0030		23,2015	41356 1	SIN	DMP	
0031		23,2016	77626 0	STADR		
0032	REF 2 LAST 280	23,2017	63734 1	STOOL	STARM +2	SIN(SA)SIN(TA)
0033		23,2020	77746 1	COS		
0034	REF 3 LAST 280	23,2021	24045 0	STOVL	STARM +4	
0035	REF 4 LAST 280	23,2022	00041 1		STARM	STARM = 32D
0036		23,2023	76521 0	MXV	VSL1	
0037	REF 1	23,2024	06302 0		NB1NB2	
0038		23,2025	00041 1	STORE	32D	
0039		23,2026	77616 0	RVO		
0040	REF 1	23,2027	3 2323 1	SXTLOGIC	CAF 10DEGS.	CORRECT FOR 19.775 DEGREE OFFSET
0041	REF 33 LAST 257	23,2030	26 154 0	ADS	MPAC	
0042	REF 1	23,2031	3 4676 1	CAF	QUARTER	
0043	REF 1	23,2032	0 7256 1	TC	SHORTMP	
0044	REF 1	23,2033	0 6030 1	TC	DANZIG	

USER'S PAGE NO. 2 E0 S3

R0052 THE INPUTS ARE 1) THE STAR VECTOR REFERRED TO PRESENT STABLE MEMBER COORDINATES STORED AT STAR. 2) SAME ANGLE
R0054 INPUT AS *S*NB*, I.E. SINES AND COSINES OF THE CDU ANGLES, IN THE ORDER Y Z X, AT SINCDU AND COSCDU. A CALL
R0056 TO CDUTRIG WILL PROVIDE THIS INPUT.

R0059	EQUAL TO ZERO).					CALCSXA	ITA	VLOAD	PUSHDOWN	00-28D,28D,30D,32D-36D
0060				23,2034	77220 1			28D		
0061				23,2035	00034 0			STAR		
0062	REF	6	LAST	277	23,2036	02766 1				
0063					23,2037	77624 1	CALL			
0064	REF	1			23,2040	47577 1		*SMNB*		
0065					23,2041	76521 0	MKV	VSL1		
0066	REF	1			23,2042	06280 0		NB2NB1		
0067	REF	7	LAST	261	23,2043	26766 1	STOVL	STAR		
0068	REF	1			23,2044	15330 0		H1UNITX		
0069	REF	2	LAST	91	23,2045	26555 0	STOVL	XNB1		
0070	REF	1			23,2046	15326 1		H1UNITY		
0071	REF	2	LAST	91	23,2047	26563 0	STOVL	YNB1		
0072	REF	1			23,2050	15324 0		H1UNITZ		
0073	REF	2	LAST	91	23,2051	36571 1	STCALL	ZNR1		
0074	REF	1			23,2052	46076 1		SXTANG1		



L CSM GEOMETRY

USER'S PAGE NO. 3 E0 S3

R0075 SXTANG COMPUTES THE SEXTANT SHAFT AND TRUNNION ANGLES REQUIRED TO POSITION THE OPTICS SUCH THAT A STAR LINE-OF-SIGHT LIES ALONG THE STAR VECTOR.

R0078 THE INPUTS ARE 1) THE STAR VECTOR REFERRED TO ANY COORDINATE SYSTEM STORED AT STAR. 2) THE NAVIGATION BASE COORDINATES REFERRED TO THE SAME COORDINATE SYSTEM. THESE THREE HALF-UNIT VECTORS ARE STORED AT XNB, YNB, AND ZNB.

R0083 THE OUTPUTS ARE THE SEXTANT SHAFT AND TRUNNION ANGLES STORED DP AT SAC AND PAC RESPECTIVELY. (LOW ORDER PART EQUAL TO ZERO).

0088				23,2053	47020 0	SXTANG	ITA	RTB		PUSHDOWN 16D,18D,22D-26D,28D
0087				23,2054	00034 0			28D		
0088	REF	1		23,2055	45857 1			TRANSP1		EREF WRT NB2
0089				23,2058	84375 1		VLOAD	MXV		
0090	REF	1		23,2057	02714 1			XNB		
0091	REF	2	LAST	281	23,2060	08280 0		NB2NB1		
0092				23,2061	77772 0		VSL1			
0093	REF	3	LAST	281	23,2062	28555 0	STOVL	XNB1		
0094	REF	1		23,2063	02722 1			YNB		
0095				23,2064	78521 0		MXV	VSL1		
0096	REF	3	LAST	282	23,2065	08280 0		NB2NB1		
0097	REF	3	LAST	281	23,2066	28583 0	STOVL	YNB1		
0098	REF	1		23,2067	02730 1			ZNB		
0099				23,2070	78521 0		MXV	VSL1		
0100	REF	4	LAST	282	23,2071	08260 0		NB2NB1		
0101	REF	3	LAST	281	23,2072	02571 0	STORE	ZNB1		
0102				23,2073	47034 0		RTB	RTB		
0103	REF	2	LAST	282	23,2074	45857 1		TRANSP1		
0104	REF	1		23,2075	45873 1			TRANSP2		
0105				23,2078	47375 0	SXTANG1	VLOAD	VXV		
0106	REF	4	LAST	282	23,2077	02571 0		ZNB1		
0107	REF	8	LAST	281	23,2100	02788 1		STAR		
0108				23,2101	77800 1		BOV			
0109				23,2102	48103 1			+1		
0110				23,2103	40058 0		UNIT	BOV		
0111	REF	1		23,2104	48145 0			ZNB=S1		
0112	REF	1		23,2105	00027 1		STORE	PDA		PDA = UNIT(ZNB X S)
0113				23,2106	57441 1		DOT	DCOMP		
0114	REF	4	LAST	282	23,2107	02555 0		XNB1		
0115	REF	1		23,2110	24023 0		STOVL	SINTH		SIN(SA) = PDA . -XNB
0116	REF	2	LAST	282	23,2111	00027 1		PDA		
0117				23,2112	77641 1		DOT			
0118	REF	4	LAST	282	23,2113	02583 0		YNB1		
0119	REF	1		23,2114	34021 0		STCALI	COSTH		COS(SA) = PDA . YNB
0120	REF	1		23,2115	47211 0		ARCTRIG			



L CSM GEOMETRY

USER=8 PAGE NO. 4 E0 S3

0121				23,2116	77634 0
0122	REP	1		23,2117	45543 1
0123	REP	4	LAST 277	23,2120	26774 1
0124	REP	9	LAST 282	23,2121	02766 1
0125				23,2122	77600 1
0126				23,2123	46124 1
0127				23,2124	72441 0
0128	REP	5	LAST 282	23,2125	02571 0
0129				23,2126	77726 1
0131				23,2127	62440 0
0132	REP	1		23,2130	46142 1
0133				23,2131	45200 1
0134	REP	2	LAST 263	23,2132	46142 1
0135	REP	1		23,2133	06331 0
0136				23,2134	77634 0
0137	REP	2	LAST 263	23,2135	45543 1
0138	REP	4	LAST 277	23,2136	02776 0
0139				23,2137	77614 1
0140	REP	1		23,2140	01630 0
0141				23,2141	00034 0
0142				23,2142	77614 1
0143	REP	2	LAST 283	23,2143	01430 1
0144				23,2144	00034 0
0145				23,2145	77745 1
0146	REP	1		23,2146	06325 0
0147	REP	5	LAST 263	23,2147	16774 1
0148	REP	1		23,2150	06327 1
0149	REP	5	LAST 283	23,2151	02776 0
0150				23,2152	77614 1
0151	REP	3	LAST 263	23,2153	01630 0
0152				23,2154	00034 0

RTB	
1STO2S	
STOVL	SAC
	STAR
BOV	
+1	
DOT	SL1
	ZNB1
ACOS	
BMN	SL2
	SXTALARM
BOV	DSJ
	SXTALARM
	20DEG-
RTB	
1STO2S	
STORE	PAC
CLRG0	
	CULTFLAG
	28D
SXTALARM	SEIGO
	CULTFLAG
	28D
ZNB=S1	DLOAD
	270DEG
STOVL	SAC
	20DEGS-
STORE	PAC
CLRG0	
	CULTFLAG
	28D

TRUNNION ANGLE NEGATIVE

TRUNNION ANGLE GREATER THAN 90 DEGREES

FOR FLIGHT USE, CULTFLAG IS ON IF
TRUNION IS GREATER THAN 90 DEG

ALARM HAS BEEN REMOVED FROM THIS

SUBROUTINE,ALARM WILL BE SET BY MPI

USER'S PAGE NO. 5 E0 S3

R0184	OUTPUT					
R0185	R(T) IN RN, V(T) IN VN, T IN PIPTIME					
R0186	OR					
R0187	R(T) IN R-OTHER, V(T) IN V-OTHER (T IS DEFINED BY T-OTHER)					
0188				23,2155		BANK 23
0189	REF	1		10,2000		SETLOC COMGEOM2
0170				10,2237		BANK
0171	REF	1				COUNT 10/GEOM
0172				10,2237	43414 1	BOF RVO
01721	REF	1		10,2240	04758 1	AVENIDSW
01722				10,2241	20242 1	+1
01723				10,2242	53775 1	VLOAD VSL*
0173	REF	2	LAST	83	10,2243	TDELTA V
0174					10,2244	0 -7,2
0175					10,2245	VAD VSL*
0178	REF	2	LAST	83	10,2246	RCV
0177					10,2247	0,2
0178	REF	4	LAST	188	10,2250	STOVL RN
0179	REF	2	LAST	83	10,2251	TNOV
0180					10,2252	VSL* VAD
0181					10,2253	0 -4,2
0182	REF	2	LAST	83	10,2254	VCV
0183					10,2255	VSL*
0184					10,2256	0,2
0185	REF	4	LAST	168	10,2257	STOVL VN
0188	REF	3	LAST	287	10,2260	TET
0187	REF	3	LAST	168	10,2281	STORE PIPTIME
0188					10,2262	RVO
0189					10,2263	VLOAD VSL*
0190	REF	3	LAST	284	10,2264	TDELTA V
0191					10,2285	0 -7,2
0192					10,2266	VAD VSL*
0193	REF	3	LAST	284	10,2267	RCV

SW=1=AVETOMID DOING W-MATRIX INTEG



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28,1966 KOOLADE .069 PAGE 285

L CSM GEOMETRY

USER=8 PAGE NO. 6 E0 93

0194				10,2270	57576 1		0,2
0195	REP	4	LAST	168	10,2271	25722 1	STOVL R-OTHER
0196	REP	3	LAST	284	10,2272	01527 0	TNUV
0197				10,2273	53257 1		VSL* VAD
0198				10,2274	57602 1		0 -4,2
0199	REP	3	LAST	284	10,2275	01543-1	VCV
0200				10,2276	77657 0		VSL*
0201				10,2277	57576 1		0,2
0202	REP	4	LAST	168	10,2300	01730 1	STORE V-OTHER
0203				10,2301	77616 0		RVD

L CSM GEOMETRY

USER'S PAGE NO. 7 E0 S3

P0204 SUBROUTINE TO COMPUTE THE NATURAL LOG OF C(MPAC, MPAC +1).

R0205 ENTRY' CALL
R0206 LOG

R0207 SUBROUTINE RETURNS WITH -LOG IN DP MPAC.

R0208 BANK IS ARBITRARY.

0209			14,2000		BANK 14
0210	REF 1		23,2000		SETLOC POWFLIT2
0211			23,2155		BANK
0212	REF 2	LAST 260 TO 284	109 109*		COUNT 23/GEOM
0213			23,2155	44301 0	LOG
0214	REF 34	LAST 280	23,2156	00160 0	NORM BDSU
0215	REF 1		23,2157	06212 0	MPAC +3
0216			23,2160	77776 1	NEARLY1
0217	REF 1		23,2161	0 7171 1	EXIT
0218			23,2162	00002 0	TC POLY
0219			23,2163	00000 1	DEC 2
0220			23,2164	00000 1	2DEC 0
0221			23,2165	01001 1	2DEC .031335467
0222			23,2166	14636 1	2DEC .0130145659
0223			23,2167	00325 0	2DEC .0215736696
0224			23,2170	07310 1	
0225			23,2171	00541 1	
0226			23,2172	16735 1	
0227	REF 24	LAST 261	23,2173	3 4714 1	CAP ZERO
0228	REF 35	LAST 266	23,2174	54 156 1	TS MPAC +2
0229			23,2175	0 0006 1	EXTEND
0230	REF 1		23,2176	3 2214 1	DCA CLOG2/32
0231	REF 36	LAST 266	23,2177	52 155 1	DXCH MPAC
0232	REF 37	LAST 266	23,2200	52 160 1	DXCH MPAC +3
0233			23,2201	4 0000 0	COM
0234	REF 2	LAST 280	23,2202	0 7256 1	TC SHORTMP
0235			23,2203	52 156 1	DXCH MPAC +1
0236			23,2204	52 155 1	DXCH MPAC
0237			23,2205	52 160 1	DXCH MPAC +3
0238			23,2206	20 155 1	DAS MPAC
0239			23,2207	0 6006 1	TC INTPRET
0240			23,2210	77616 0	RVO
0241			23,2211	37777 1	NEARLY1 2DEC .999999999
0242			23,2212	37777 1	

GENERATES LOG BY SHIFTING ARG
UNTIL IT LIES BETWEEN .5 AND 1.
THE LOG OF THIS PART IS FOUND AND THE
LOG OF THE SHIFTED PART IS COMPUTED

AND ADDED IN. SHIFT COUNT STORED

(N-1, SUPPLIED BY SMERZH)
IN MPAC +3.

LOAD POSITIVE SHIFT COUNT IN A.
MULTIPLY BY SHIFT COUNT.

RESULT IN MPAC, MPAC +1



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28, 1968 KOOLADE .069 PAGE 287

L CSM GEOMETRY

USER'S PAGE NO. 8 Eo 53

0238
0238

23,2213 00542 1 CLOG2/32 2DEC .0216608494
23,2214 34414 1



L CSM GEOMETRY

USER=8 PAGE NO. 9 E0 S3

R0239 SUBROUTINE NAME' EARTH ROTATOR (EARROT1 OR EARROT2)
 R0241 MOD NO' N +1
 R0243 MOD BY' ENTRY GROUP (BAIRNSFATHER)
 R0244 FUNCTIONAL DESCRIPTION' THIS ROUTINE PROJECTS THE INITIAL EARTH TARGET VECTOR RTINIT AHEAD THROUGH
 R0246 THE ESTIMATED TIME OF FLIGHT. INITIAL CALL RESOLVES THE INITIAL TARGET VECTOR RTINIT INTO EASTERLY
 R0248 AND NORMAL COMPONENTS RTEAST AND RINORM. INITIAL AND SUBSEQUENT CALLS ROTATE THIS VECTOR
 R0250 ABOUT THE (FULL) UNIT POLAR AXIS UNITW THROUGH THE ANGLE WIE DTEAROT TO OBTAIN THE ROTATED
 R0252 TARGET VECTOR RT. ALL VECTORS EXCEPT UNITW ARE HALF UNIT.
 R0254 THE EQUATIONS ARE
 R0255
 R0256 $RT = RTINIT + RINORM (\cos(WT) - 1) + RTEAST \sin(WT)$
 R0257 WHERE $WT = WIE DTEAROT$
 R0258 $RTINIT = \text{INITIAL TARGET VECTOR}$
 R0259
 R0260 $RTEAST = UNITW * RTINIT$
 R0261
 R0262 $RINORM = RTEAST * UNITW$
 R0263
 R0265 FOR CONTINUOUS UPDATING, ONLY ONE ENTRY TO EARROT1 IS REQUIRED, WITH SUBSEQUENT ENTRIES AT EARROT2.
 R0266 CALLING SEQUENCE' FIRST CALL SUBSEQUENT CALL
 R0267 STCALL DTEAROT STCALL DTEAROT
 R0268 EARROT1 EARROT2
 R0269 C(MPAC) UNSPECIFIED C(MPAC) = DTEAROT
 R0270 PUSHLOC = PDL+0, ARBITRARY. 6 LOCATIONS USED.
 R0271
 R0272 SUBROUTINES USED' NONE
 R0273 NORMAL EXIT MODES' RVQ
 R0274 ALARMS' NONE
 R0275 OUTPUT' RTEAST (-1) .5 UNIT VECTOR EAST, COMPT OF RTINIT LEFT BY FIRST CALL
 R0276 RINORM (-1) .5 UNIT VECTOR NORML, COMPT OF RTINIT LEFT BY FIRST CALL
 R0277 RT (-1) .5 UNIT TARGET VECTOR, ROTATED LEFT BY ALL CALLS
 R0279 DTEAROT (-28) CS MAY BE CHANGED BY EARROT2, IF OVER 1 DAY
 R0280 ERASABLE INITIALIZATION REQUIRED
 R0281 UNITW (0) UNIT POLAR VECTOR PAD LOADED
 R0283 RTINIT (-1) .5 UNIT INITIAL TARGET VECTOR LEFT BY ENTRY
 R0285 DTEAROT (-28) CS TIME OF FLIGHT LEFT BY CALLER
 R0287 DEBRIS' OPRET; PDL+0 ... PDL+5



L CSM GEOMETRY

USER=8 PAGE NO. 10 E0 S3

P0288

0289	REP	3	LAST	210	E7,1451	EBANK=	RTINIT				
0290					23,2215	47375	0	EARROT1	VLOAD	VXV	
0291	REP	3	LAST	84	23,2216	01714	1			UNITW	FULL UNIT VECTOR
0292	REP	4	LAST	289	23,2217	03452	1			RTINIT	.5 UNIT
0293	REP	2	LAST	116	23,2220	03460	0		STORE	RTEAST	.5 UNIT
0294					23,2221	77635	1		VXV		
0295	REP	4	LAST	289	23,2222	01714	1			UNITW	FULL UNIT
0296	REP	2	LAST	116	23,2223	17466	0		STODL	RNORM	.5 UNIT
0297	REP	2	LAST	116	23,2224	03606	1			DTEAROT	(-26) CS
0298					23,2225	56204	1	EARROT2	BOVB	DDV	
0299	REP	1			23,2226	57343	1			TDANZIG	RESET OVPIND, IF ON
0300	REP	1			23,2227	06256	0			1/WIE	
0301					23,2230	41400	0		BOV	PUSH	
0302	REP	1			23,2231	46245	0			OVERADAY	
0303					23,2232	45346	1		COS	DSU	
0304	REP	1			23,2233	15330	0			HIDPHALP	
0305					23,2234	65361	0		VXSC	PDDL	XCH W PUSH LIST
0306	REP	3	LAST	289	23,2235	03466	0			RNORM	.5 UNIT
0307					23,2236	74356	1		SIN	VXSC	
0308	REP	3	LAST	289	23,2237	03460	0			RTEAST	.5 UNIT
0309					23,2240	76455	1		VAD	VSL1	
0310					23,2241	53455	0		VAD	UNIT	INSURE THAT RT IS "UNIT".
0311	REP	5	LAST	289	23,2242	03452	1			RTINIT	.5 UNIT
0312	REP	2	LAST	116	23,2243	03474	0		STORE	RT	.5 UNIT TARGET VECTOR
0313					23,2244	77616	0		RVO		
0314					23,2245	75345	1	OVERADAY	DLOAD	SIGN	
0315	REP	2	LAST	289	23,2246	06256	0			1/WIE	
0316	REP	3	LAST	289	23,2247	03606	1			DTEAROT	
0317					23,2250	77621	1		BDSU		
0318	REP	4	LAST	289	23,2251	03606	1			DTEAROT	
0319	REP	5	EAST	289	23,2252	03606	1		STORE	DTEAROT	
0320					23,2253	77650	1		GOTO		
0321	REP	1			23,2254	48225	0			EARROT2	
A0322								WIE	2DEC	.1901487997	
0323					23,2255	01015	1	1/WIE	2DEC	8616410	
0323					23,2256	34732	0				
1036					23,2257	15373	1	NB2NB1	2DEC	+.8431756920 R-1	
1036					23,2260	11346	0				
1037					23,2261	00000	1		2DEC	0	
1037					23,2262	00000	1				
1036					23,2263	67313	1		2DEC	-.5376381241 R-1	
1036					23,2264	65307	0				



L CSM GEOMETRY

USRA-S PAGE NO. 11 E7 83

1039	23,2265	00000 1	ZERINFLT 2DEC	0
1039	23,2266	00000 1		
1040	23,2267	20000 0	HALFNFLT 2DEC	.5
1040	23,2270	00000 1		
1041	23,2271	00000 1	2DEC	0
1041	23,2272	00000 1		
1042	23,2273	10464 0	2DEC	+.5376361241 B-1
1042	23,2274	12470 1		
1043	23,2275	00000 1	2DEC	0
1043	23,2276	00000 1		
1044	23,2277	15373 1	2DEC	+.6431756920 B-1
1044	23,2300	11346 0		
1045	23,2301	15373 1	NB ₁ NB ₂ 2DEC	+.6431756920 B-1
1045	23,2302	11346 0		
1046	23,2303	00000 1	2DEC	0
1046	23,2304	00000 1		
1047	23,2305	10464 0	2DEC	+.5376361241 B-1
1047	23,2306	12470 1		
1046	23,2307	00000 1	2DEC	0
1046	23,2310	00000 1		
1049	23,2311	20000 0	2DEC	.5
1049	23,2312	00000 1		
1050	23,2313	00000 1	2DEC	0
1050	23,2314	00000 1		
1051	23,2315	67313 1	2DEC	-.5376361241 B-1
1051	23,2316	65307 0		
1052	23,2317	00000 1	2DEC	0
1052	23,2320	00000 1		
1053	23,2321	15373 1	2DEC	+.6431756920 B-1
1053	23,2322	11346 0		



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 26, 1968 KOOLADE .069 PAGE 291

L CSM GEOMETRY

USER'S PAGE NO. 12 E7 83

1054	23,2323	07020 1	10DEGS-	DEC	3600
1055	23,2324	60000 1	270DEG	OCT	60000
1056	23,2325	00000 1		OCT	00000
1057	23,2326	61740 0	20DEGS-	DEC	-07199
1058	23,2327	77777 0		DEC	-00000
1059	23,2330	07020 1	20DEG-	DEC	03600
1060	23,2331	00000 1		DEC	00000

SHAFT 270 DEGREES 2S COMP.

USER'S PAGE NO. 1 E0 S3

0001	000101	REF	1		07,2440				BANK 7		
000102					06,2000				SETLOC	IMUCOMP	
0002	REF	2	LAST	62	06,3262				BANK		
					E3,1460				EBANK=	NBDX	
0100	REF	1							COUNT	06/ICOMP	
0112	REF	1			06,3262	3 3516 0	1/PIPA		CAP	LOGCOMP	
0113	REF	14	LAST	261	06,3263	56 003 1			XCH	EBANK	SAVE EBANK OF CALLING PROGRAM
0114	REF	1			06,3264	54 163 1			TS	MODE	
0115	REF	1			06,3265	11*477 0			CCS	GCMPSPW	BYPASS IF GCMPSPW NEGATIVE
0116					06,3266	1 3271 1			TCF	+3	
0117					06,3267	1 3271 1			TCF	+2	
0118	REF	1			06,3270	1 3407 0			TCF	IRIG1	RETURN
01181					06,3271	0 0004 0			INHINT		
A01182											ASSURE COMPLETE COMPENSATION OF DELV=8
0119	REF	1			06,3272	3 4710 0	1/PIPA1		CAP	FOUR	FOR DOWNLINK.
0120	REF	4	LAST	68	06,3273	54 132 0			TS	BUF +2	PIPAZ, PIPAY, PIPAX
0121	REF	5	LAST	292	06,3274	50 132 1			INDEX	BUF +2	
0122	REF	1			06,3275	3 1453 1			CA	PIPA SCP	(P.P.M.) X 2(-9)
0123					06,3276	0 0006 1			EXTEND		
0124	REF	6	LAST	292	06,3277	5 0132 1			INDEX	BUF +2	
0125	REF	1			06,3300	7 1162 1			MP	DELX	(PP) X 2(+14) NOW (PIPA PULSES) X 2(+5)
0126	REF	32	LAST	265	06,3301	54 002 1			TS	Q	SAVE MAJOR PART
0127	REF	20	LAST	240	06,3302	3 0001 0			CA	L	MINOR PART
0128					06,3303	0 0006 1			EXTEND		
0129	REF	24	LAST	219	06,3304	7 4705 0			MP	BIT6	SCALE 2(+9) SHIFT RIGHT 9
0130	REF	7	LAST	292	06,3305	50 132 1			INDEX	BUF +2	
0131	REF	2	LAST	292	06,3306	55*163 0			TS	DELX +1	FRACTIONAL PIPA PULSES SCALED 2(+14)
0132	REF	33	LAST	292	06,3307	3 0002 0			CA	Q	MAJOR PART
0133					06,3310	0 0006 1			EXTEND		
0134	REF	25	LAST	292	06,3311	7 4705 0			MP	BIT6	SCALE 2(+9) SHIFT RIGHT 9
0135	REF	6	LAST	292	06,3312	50 132 1			INDEX	BUF +2	
0136	REF	3	LAST	292	06,3313	21*163 0			DAS	DELX	(PIPAI) + (PIPAI)(SPE)
0137	REF	9	LAST	292	06,3314	50 132 1			INDEX	BUF +2	
0138	REF	1			06,3315	4 1452 1			CS	PIPARIAS	(PIPA PULSES)/(CS) X 2(-6) *
0139					06,3316	0 0006 1			EXTEND		
0140	REF	2	LAST	75	06,3317	7 1074 1			MP	1/PIPADT	(CS) X 2(+8) NOW (PIPA PULSES) X 2(+0)*
0141					06,3320	0 0006 1			EXTEND		
0142	REF	27	LAST	256	06,3321	7 4712 0			MP	BIT1	SCALE 2(+14) SHIFT RIGHT 14 *
0143	REF	10	LAST	292	06,3322	50 132 1			INDEX	BUF +2	
0144	REF	4	LAST	292	0						



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28, 1988 KOOLADE .069 PAGE 293

L IMU COMPENSATION PACKAGE

USER'S PAGE NO. 2 E3 S3

0146	REP	1	06,3325	6 7716 0
0147	REP	1	06,3326	1 3273 0
0148			06,3327	13 330 0
01481			06,3330	0 0003 1

AD NEG1
TCP 1/PIPA1 +1
NOOP
RELINT

LESS THAN ZERO IMPOSSIBLE.



L IMU COMPENSATION PACKAGE

USER=5 PAGE NO. 3 E3 93

P01482

REP	2	LAST	292	06,3331	55477 0	IRIGCOMP TS	GCMPSW	
0149	REP	12	LAST	292	06,3332	54 130 1	TS	BUF
INDICATE COMMANDS 2 PULSES OR LESS INDEX COUNTER - IRIGX, IRIGY, IRIGZ								
0151					06,3333	0 0008 1	IRIGX	EXTEND
0152	REP	5	LAST	292	06,3334	4 1183 0	DCS	DELAV
0153	REP	42	LAST	286	06,3335	52 155 1	DXCH	MPAC
0154	REP	1			06,3336	3 1483 1	CA	ADIAV
0155	REP	1			06,3337	0 3412 0	TC	GCMPSUB
(PIPA PULSES) X 2(+14)								
0156					06,3340	0 0008 1	EXTEND	
0157	REP	1			06,3341	4 1185 0	DCS	DELAV
0158	REP	43	LAST	294	06,3342	52 155 1	DXCH	MPAC
0159	REP	1			06,3343	4 1488 0	CS	ADSRAX
0160	REP	2	LAST	294	06,3344	0 3412 0	TC	GCMPSUB
(GYRO PULSES)/(PIPA PULSE) X 2(-3) *								
-(ADIAV)(PIPAV) (GYRO PULSES) X 2(+14)								
A01603							EXTEND	***
A01604							DCS	DELAV
A01605							DXCH	MPAC
A01606							CA	ADIAV
A01607							TC	GCMPSUB
(PIPA PULSES) X 2(+14)								
0161	REP	3	LAST	292	06,3345	4 1480 0	CS	NBDX
0162	REP	1			06,3346	0 3441 0	TC	DRIFTSUB
(GYRO PULSES)/(CS) X 2(-5)								
0163					06,3347	0 0008 1	IRIGY	EXTEND
0164	REP	2	LAST	294	06,3350	4 1185 0	DCS	DELAV
0165	REP	44	LAST	294	06,3351	52 155 1	DXCH	MPAC
0166	REP	1			06,3352	3 1484 0	CA	ADIAV
0167	REP	3	LAST	294	06,3353	0 3412 0	TC	GCMPSUB
(GYRO PULSES)/(PIPA PULSE) X 2(-3) *								
-(ADIAV)(PIPAV) (GYRO PULSES) X 2(+14)								
0168					06,3354	0 0008 1	EXTEND	
0169	REP	1			06,3355	4 1187 1	DCS	DELAV
0170	REP	45	LAST	294	06,3356	52 155 1	DXCH	MPAC
0171	REP	1			06,3357	4 1487 1	CS	ADSRAY
0172	REP	4	LAST	294	06,3360	0 3412 0	TC	GCMPSUB
(GYRO PULSES)/(PIPA PULSE) X 2(-3) *								
+(ADSRAY)(PIPAZ) (GYRO PULSES) X 2(+14)								
A01723							EXTEND	***
A01724							DCS	DELAV
A01725							DXCH	MPAC
A01726							CA	ADIAV
A01727							TC	GCMPSUB
(PIPA PULSES) X 2(+14)								
0173	REP	1			06,3361	4 1481 1	CS	NBDY
0174	REP	2	LAST	294	06,3362	0 3441 0	TC	DRIFTSUB
(GYRO PULSES)/(CS) X 2(-5)								
0175					06,3363	0 0008 1	IRIGZ	EXTEND
0176	REP	3	LAST	294	06,3364	4 1185 0	DCS	DELAV
0177	REP	46	LAST	294	06,3365	52 155 1	DXCH	MPAC
0178	REP	1			06,3366	3 1470 0	CA	ADSRAY
(GYRO PULSES)/(PIPA PULSE) X 2(-3) *								



L IMU COMPENSATION PACKAGE

USER'S PAGE NO. 4 E3 S3

0179	REP	5	LAST	294	08,3367	0 3412 0	TC	GCOMPSUB	-(ADSRZ)(PIPAY) (GYRO PULSES) X 2(+14)
0180					08,3370	0 0006 1	EXTEND		
0181	REP	2	LAST	294	08,3371	4 1187 1	DCS	DELVZ	(PIPA PULSES) X 2(+14)
0182	REP	47	LAST	294	08,3372	52 155 1	DXCH	MPAC	
0183	REP	1			08,3373	3 1485 1	CA	ADIAZ	(GYRO PULSES)/(PIPA PULSE) X 2(-3) *
0184	REP	6	LAST	295	08,3374	0 3412 0	TC	GCOMPSUB	-(ADIAZ)(PIPAZ) (GYRO PULSES) X 2(+14)
A01843							EXTEND	***	
A01844							DCS	DELVX	*** (PIPA PULSE) X 2(+14)
A01845							DXCH	MPAC	***
A01846							CS	ADOAZ	*** (GYRO PULSES)/(PIPA PULSE) X 2(-3) *
A01847							TC	GCOMPSUB	*** +(ADOAZ)(PIPAZ) (GYRO PULSES) X 2(+14)
0185	REP	1			08,3375	3 1482 0	CA	NBDZ	(GYRO PULSES)/(CS) X 2(-5)
0188	REP	3	LAST	294	08,3378	0 3441 0	TC	DRIFTSUB	+(NBDZ)(DELTAT) (GYRO PULSES) X 2(+14)



L IMU COMPENSATION PACKAGE

0187	REF	3	LAST	294	06,3377	11=477 0	CCS	GCORPSW
0188					06,3400	1 3402 0	TOP	+2
0189	REF	2	LAST	292	06,3401	1 3407 0	TOP	IRIG1
0191	REF	1			06,3402	3 4764 0	CAP	PRIO17
0192	REF	10	LAST	251	06,3403	0 5027 1	TC	NOVAC
0193	REF	4	LAST	294	E3,1480		EBANK	NEOX
0194	REF	1			06,3404	03474 0	2CADR	1/GYRO
0194	REF	1			06,3405	14083 1		
0195					06,3408	0 0003 1	RELINT	
0196	REF	2	LAST	292	06,3407	3 0183 0	IRIG1	CA MODE
0197	REF	15	LAST	292	06,3410	54 003 0	TS	EBANK
0198	REF	5	LAST	216	06,3411	1 4570 0	TOP	SWRSTURN
0199	REF	46	LAST	295	06,3412	58 154 1	GCOMP SUB	XCH MPAC
0200					06,3413	0 0008 1	EXTEND	
0201	REF	49	LAST	298	06,3414	7 0154 0	MP	MPAC
0202	REF	14	LAST	68	06,3415	52 123 0	DACH	VRUP
0203	REF	50	LAST	296	06,3418	3 0155 0	CA	MPAC +1
0204					06,3417	0 0008 1	EXTEND	
0205	REF	51	LAST	296	06,3420	7 0154 0	MP	MPAC
0206	REF	21	LAST	292	06,3421	54 001 1	TS	L
0207	REF	25	LAST	266	06,3422	3 4714 1	CAP	ZERO
0208	REF	15	LAST	296	06,3423	20 123 0	DAS	VRUP
0209	REF	16	LAST	296	06,3424	3 0122 0	CA	VRUP
0210					06,3425	0 0008 1	EXTEND	
0211	REF	15	LAST	227	06,3428	7 4877 1	MP	BIT12
0212	REF	13	LAST	294	06,3427	50 130 0	INDEX	RUP
0213	REF	3	LAST	63	06,3430	21=472 0	DAS	GCOMP
0214	REF	17	LAST	296	06,3431	3 0123 1	CA	VRUP +1
0215					06,3432	0 0008 1	EXTEND	
0216	REF	16	LAST	296	06,3433	7 4877 1	MP	BIT12
0217	REF	22	LAST	296	06,3434	54 001 1	TS	L
0218	REF	26	LAST	296	06,3435	3 4714 1	CAP	ZERO
0219	REF	14	LAST	296	06,3438	50 130 0	INDEX	RUP
0220	REF	4	LAST	296	06,3437	21=472 0	DAS	GCOMP
0221	REF	34	LAST	292	06,3440	0 0002 0	TC	0

USER'S PAGE NO. 5 E3 S3

ARE GYRO COMMANDS GREATER THAN 2 PULSES
YES
NO

LEM PRIORITY HIGHER-THIS FOR PRELAUNCH

SET EBANK FOR RETURN

ADIA OR ADSRA COEFFICIENT ARRIVES IN A
 $C(MPAC) = (PIPA \text{ PULSES}) \times 2^{(+14)}$
 $(GYRO \text{ PULSES}) / (PIPA \text{ PULSE}) \times 2^{(-3)}$ *
 $NOW = (GYRO \text{ PULSES}) \times 2^{(+11)}$ *

MINOR PART PIPA PULSES

ADIA OR ADSRA

 $NOW = (GYRO \text{ PULSES}) \times 2^{(+11)}$ *

PARTIAL RESULT - MAJOR

SCALE $2^{(+3)}$ SHIFT RIGHT 3 *
RESULT = $(GYRO \text{ PULSES}) \times 2^{(+14)}$
HI(ADIA)(PIPAI) OR HI(ADSRA)(PIPAI)

PARTIAL RESULT - MINOR

SCALE $2^{(+3)}$ SHIFT RIGHT 3 *RESULT = $(GYRO \text{ PULSES}) \times 2^{(+14)}$
(ADIA)(PIPAI) OR (ADSRA)(PIPAI)



L IMU COMPENSATION PACKAGE

USER=3 PAGE NO. 6 E3 S3

0222				06,3441	0 0006 1	DRIFTSUB	EXTEND	
0223	REP	15	LAST	296	06,3442	22 131 1	QXCH	BUF +1
0224				06,3443	0 0006 1		EXTEND	
0225	REP	3	LAST	292	06,3444	7 1074 1	MP	1/PIPADT
0226	REP	52	LAST	296	06,3445	22 155 0	LXCH	MPAC +1
0227				06,3446	0 0006 1		EXTEND	
0228	REP	20	LAST	250	06,3447	7 4707 1	MP	BIT4
0229	REP	16	LAST	297	06,3450	50 130 0	INDEX	BUF
0230	REP	5	LAST	296	06,3451	21=472 0	DAS	GCOMP
0231	REP	53	LAST	297	06,3452	3 0155 0	CA	MPAC +1
0232				06,3453	0 0006 1		EXTEND	
0233	REP	21	LAST	297	06,3454	7 4707 1	MP	BIT4
0234	REP	23	LAST	296	06,3455	54 001 1	TS	L
0235	REP	27	LAST	296	06,3456	3 4714 1	CAP	ZERO
0236	REP	17	LAST	297	06,3457	50 130 0	INDEX	BUF
0237	REP	6	LAST	297	06,3460	21=472 0	DAS	GCOMP
0238	REP	6	LAST	265	06,3461	3 4711 1	DRIFTSUB2	CAP TWO
0239	REP	16	LAST	297	06,3462	6 0130 0	AD	BUF
0240	REP	19	LAST	297	06,3463	56 130 0	XCH	BUF
0241	REP	74	LAST	266	06,3464	50 000 1	INDEX	A
0242	REP	7	LAST	297	06,3465	11=471 0	CCS	GCOMP
0243				06,3466	1 3470 0		TCF	+2
0244	REP	20	LAST	297	06,3467	0 0131 1	TC	BUF +1
0245	REP	10	LAST	253	06,3470	7 7716 1	MASK	NEGONE
0246	REP	75	LAST	297	06,3471	10 000 0	CCS	A
0247	REP	4	LAST	296	06,3472	55=477 0	TS	GCOMP SW
0248	REP	21	LAST	297	06,3473	0 0131 1	TC	BUF +1

C(A) = NBD (GYRO PULSES)/(CS) X 2(-5)
(CS) X 2(+6) NOW (GYRO PULSES) X 2(+3)
SAVE FOR FRACTIONAL COMPENSATION

SCALE -2(+11) SHIFT RIGHT 11

HI(NBD)(DELTAT) (GYRO PULSES) X 2(+14)

NOW MINOR PART

SCALE 2(+11) SHIFT RIGHT 11

ADD IN FRACTIONAL COMPENSATION
(NBD)(DELTAT) (GYRO PULSES) X 2(+14)

PIPAX, PIPAY, PIPAZ

ARE GYRO COMMANDS 1 PULSE OR GREATER
YES
NO

ARE GYRO COMMANDS GREATER THAN 2 PULSES
YES - SET GCOMP SW POSITIVE
NO



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 20211111-041

20'35 OCT. 26, 1966 KOOLADE .069 PAGE 296

L IMU COMPENSATION PACKAGE

USER'S PAGE NO. 7 E3 83

0249	REF	2	LAST	292	06,3474	3 4710 0	1/GYRO	CAP	FOUR
0250	REF	22	LAST	297	06,3475	54 130 1		TS	BUF
0251	REF	23	LAST	296	06,3476	50 130 0		INDEX	BUF
0252	REF	8	LAST	297	06,3477	3 1472 1		CA	GCOMP +1
0253					06,3500	0 0006 1		EXTEND	
0254	REF	16	LAST	196	06,3501	7 4703 0		MP	BITS
0255	REF	24	LAST	296	06,3502	50 130 0		INDEX	BUF
0256	REF	9	LAST	296	06,3503	55*472 0		TS	GCOMP +1
0257	REF	28	LAST	297	06,3504	3 4714 1		CAP	ZERO
0258	REF	25	LAST	296	06,3505	50 130 0		INDEX	BUF
0259	REF	10	LAST	296	06,3506	57*471 1		XCH	GCOMP
0260					06,3507	0 0006 1		EXTEND	
0261	REF	19	LAST	296	06,3510	7 4703 0		MP	BITS
0262	REF	26	LAST	296	06,3511	50 130 0		INDEX	BUF
0263	REF	11	LAST	296	06,3512	21*472 0		DAS	GCOMP
0264	REF	27	LAST	296	06,3513	10 130 1		CCS	BUF
0265	REF	2	LAST	293	06,3514	6 7716 0		AD	NEG1
0266	REF	2	LAST	296	06,3515	1 3475 0		TCF	1/GYRO +1
0267	REF	12	LAST	296	06,3516	01471 1	LGCOMP	ECADR	GCOMP
0268	REF	2	LAST	292	06,3517	3 3516 0		CAP	LGCOMP
0269	REF	35	LAST	257	06,3520	0 4555 0		TC	BANKCALL
0270	REF	2	LAST	237	06,3521	17125 1		CADR	IMPULSE
0271	REF	36	LAST	296	06,3522	0 4555 0		TC	BANKCALL
0272	REF	5	LAST	237	06,3523	17516 0		CADR	IMUSTALL
0273	REF	14	LAST	261	06,3524	1 5112 1		TCF	ENDOFJOB
0274	REF	3	LAST	296	06,3525	3 4710 0	GCOMP1	CAP	FOUR
0275	REF	28	LAST	296	06,3526	54 130 1		TS	BUF
0276	REF	29	LAST	296	06,3527	50 130 0		INDEX	BUF
0277	REF	13	LAST	296	06,3530	3 1472 1		CA	GCOMP +1
0278					06,3531	0 0006 1		EXTEND	
0279	REF	20	LAST	296	06,3532	7 4703 0		MP	BITS
0280	REF	30	LAST	296	06,3533	50 130 0		INDEX	BUF
0281	REF	14	LAST	296	06,3534	23*472 1		LXCH	GCOMP +1
0282	REF	31	LAST	296	06,3535	10 130 1		CCS	BUF
0283	REF	3	LAST	296	06,3536	6 7716 0		AD	NEG1
0284	REF	1			06,3537	1 3528 1		TCF	GCOMP1 +1
0285					06,3540	01436 1	V06N30S	VN	0630
0286	REF	15	LAST	298	06,3541	1 5112 1		TCF	ENDOFJOB

PIPAZ, PIPAY, PIPAX

SCALE GYRO COMMANDS FOR IMPULSE
FRACTIONAL PULSES

SHIFT RIGHT 7

FRACTIONAL PULSES SCALED

SET GCOMP = 0 FOR DAS INSTRUCTION

GYRO PULSES

SHIFT RIGHT 7

ADD THESE TO FRACTIONAL PULSES ABOVE

PIPAZ, PIPAY, PIPAX

LESS THAN ZERO IMPOSSIBLE

CALL GYRO TORQUING ROUTINE

WAIT FOR PULSES TO GET OUT
TEMPORARY

PIPAZ, PIPAY, PIPAX

RESCALE

SHIFT MINOR PART LEFT 7 - MAJOR PART = 0

BITS 6-14 OF MINOR PART WERE = 0

PIPAZ, PIPAY, PIPAX



L IMU COMPENSATION PACKAGE

USER'S PAGE NO. 8 E3 S3

0287	REP	5	LAST	297	06,3542	11=477 0	NEDONLY	CCS	GCOMP SW
0288					06,3543	1 3546 1		TCP	+3
0289					06,3544	1 3546 1		TCP	+2
0290	REP	10	LAST	298	06,3545	1 5112 1		TCP	ENDOPJOB
029005					06,3546	0 0004 0		INHINT	
02901	REP	6	LAST	196	06,3547	10 076 1		CCS	FLAGJRD2
02902	REP	17	LAST	299	06,3550	1 5112 1		TCP	ENDOPJOB
02903	REP	16	LAST	299	06,3551	1 5112 1		TCP	ENDOPJOB
02904					06,3552	1 3553 0		TCP	+1
0291	REP	4	LAST	215	06,3553	3 0025 0		CA	TIME1
0292	REP	4	LAST	297	06,3554	57=074 0		XCH	1/PIPADT
02925					06,3555	0 0003 1		RELINT	
0293					06,3556	4 0000 0		COM	
0294	REP	5	LAST	299	06,3557	0 1074 0		AD	1/PIPADT
0295	REP	70	LAST	297	06,3560	10 000 0	NBD2	CCS	A
0290	REP	13	LAST	285	06,3561	0 4712 1		AD	ONE
0297	REP	1			06,3562	1 3567 1		TCP	NBD3
0298					06,3563	1 3565 0		TCP	+2
0299	REP	19	LAST	299	06,3564	1 5112 1		TCP	ENDOPJOB
0300					06,3565	4 0000 0		COM	
0301	REP	6	LAST	166	06,3566	0 4672 0		AD	POS MAX
0302					06,3567	0 0006 1	NBD3	EXTEND	
0303	REP	19	LAST	225	06,3570	7 4701 1		MP	BIT10
0304	REP	16	LAST	296	06,3571	52 123 0		DXCH	VRUP
0305					06,3572	0 0006 1		EXTEND	
0306	REP	19	LAST	299	06,3573	3 0123 1		DCA	VRUP
0307	REP	54	LAST	297	06,3574	52 155 1		DXCH	MPAC
0308	REP	29	LAST	296	06,3575	3 4714 1		CAP	ZERO
0309	REP	6	LAST	299	06,3576	55=477 0		TS	GCOMP SW
0310	REP	32	LAST	296	06,3577	54 130 1		TS	BUF
0311	REP	5	LAST	296	06,3600	4 1460 0		CS	NBDX
0312	REP	1			06,3601	0 3617 1		TC	PBIASSUB
0313					06,3602	0 0006 1		EXTEND	
0314	REP	20	LAST	299	06,3603	4 0123 0		DCS	VRUP
0315	REP	55	LAST	299	06,3604	52 155 1		DXCH	MPAC
0310	REP	2	LAST	294	06,3605	3 1461 0		CA	NBDY
0317	REP	2	LAST	299	06,3606	0 3617 1		TC	PBIASSUB
0318					06,3607	0 0006 1		EXTEND	
0319	REP	21	LAST	299	06,3610	4 0123 0		DCS	VRUP
0320	REP	56	LAST	299	06,3611	52 155 1		DXCH	MPAC
0321	REP	2	LAST	295	06,3612	4 1462 1		CS	NBDZ
0322	REP	3	LAST	299	06,3613	0 3617 1		TC	PBIASSUB

BYPASS IF GCOMP SW NEGATIVE

PREREAD TRUPT MAY COINCIDE

(CS) X 2(+14)
PREVIOUS TIMECALCULATE ELAPSED TIME
NO TIME1 OVERFLOW
RESTORE TIME DIFFERENCE AND JUMP
TIME1 OVERFLOW
IF ELAPSED TIME = 0 (DIFFERENCE = -0)

CALCULATE ABSOLUTE DIFFERENCE

C(A) = DELTAT (CS) X 2(+14)
SHIFT RIGHT 5

DELTAT NOW SCALED (CS) X 2(+19)

INDICATE COMMANDS 2 PULSES OR LESS
PIPAX, PIPAY, PIPAZ(GYRO PULSES)/(CS) X 2(-5)
-(NBDX)(DELTAT) (GYRO PULSES) X 2(+14)DELTAT SCALED (CS) X 2(+19)
(GYRO PULSES)/(CS) X 2(-5)
-(NBDY)(DELTAT) (GYRO PULSES) X 2(+14)DELTAT SCALED (CS) X 2(+19)
(GYRO PULSES)/(CS) X 2(-5)
+(NBDZ)(DELTAT) (GYRO PULSES) X 2(+14)



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 26, 1966 KOOLADE .089 PAGE 300

L IMU COMPENSATION PACKAGE

USER'S PAGE NO. 9 E3 S3

0323	REF	7	LAST	299	08,3814	11-477 0
0324	REF	3	LAST	298	08,3815	1 3474 1
0325	REF	20	LAST	299	08,3818	1 5112 1

CCS	GCOMPSW
TCP	1/GYRO
TCP	ENDOPJOB

ARE GYRO COMMANDS GREATER THAN 2 PULSES
YES
NO



L IMU COMPENSATION PACKAGE

USER=8 PAGE NO. 10

E3 S3

0326	REF	35	LAST	296	06,3617	56 002 0	FBIASSUB	XCH	Q	
0327	REF	33	LAST	299	06,3620	54 131 0		TS	BUF +1	
0328	REF	36	LAST	301	06,3621	3 0002 0		CA	Q	NBD SCALED (GYRO PULSES)/(CS) X 2(-5)
0329					06,3622	0 0006 1		EXTEND		
0330	REF	57	LAST	299	06,3623	7 0154 0		MP	MPAC	DELTAT SCALED (CS) X 2(+19)
0331	REF	34	LAST	301	06,3624	50 130 0		INDEX	BUF	
0332	REF	15	LAST	296	06,3625	21=472 0		DAS	GCOMP	HI(NBD)(DELTAT) (GYRO PULSES) X 2(+14)
0333	REF	37	LAST	301	06,3626	3 0002 0		CA	Q	NOW FRACTIONAL PART
0334					06,3627	0 0006 1		EXTEND		
0335	REF	58	LAST	301	06,3630	7 0155 1		MP	MPAC +1	
0336	REF	24	LAST	297	06,3631	54 001 1		TS	L	
0337	REF	30	LAST	299	06,3632	3 4714 1		CAP	ZERO	
0338	REF	35	LAST	301	06,3633	50 130 0		INDEX	BUF	
0339	REF	16	LAST	301	06,3634	21=472 0		DAS	GCOMP	(NBD)(DELTAT) (GYRO PULSES) X 2(+14)
0340	REF	1			06,3635	1 3461 0		TCP	DRFTSUB2	CHECK MAGNITUDE OF COMPENSATION
03401	REF	37	LAST	298	06,3636	0 4555 0	LASTBIAS	TC	RANKCALL	
03402	REF	1			06,3637	17075 0		CADR	PIPUSE	
0341	REF	8	LAST	300	06,3640	11=477 0		CCS	GCOMP SW	BYPASS IF GCOMP SW NEGATIVE
0342					06,3641	1 3644 0		TCP	+3	
0343					06,3642	1 3644 0		TCP	+2	
0344	REF	21	LAST	300	06,3643	1 5112 1		TCP	ENDOFJOB	
0345	REF	1			06,3644	3 7665 0		CAP	PRI031	2 SECONDS SCALED (CS) X 2(+6)
0346	REF	6	LAST	299	06,3645	57=074 0		XCH	1/PIPADT	
0347					06,3646	4 0000 0		COM		
0348	REF	4	LAST	174	06,3647	6 1246 0		AD	PIPTIME1 +1	TIME AT PIPA1 =0
0349	REF	1			06,3650	1 3560 0		TCP	NBD2	



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 1 E0 S3

R0001 PROGRAM NAME - KEYBOARD AND DISPLAY PROGRAM
R0002 MOD NO - 4 DATE - 27 APRIL 1967 ASSEMBLY - PINDISC REV 17
R0003 MOD BY - FILENE
R0004 LOG SECTION - PINBALL GAME BUTTONS AND LIGHTS

R0009 FUNCTIONAL DESCRIPTION-

R0010 THE KEYBOARD AND DISPLAY SYSTEM PROGRAM OPERATES UNDER EXECUTIVE
R0011 CONTROL AND PROCESSES INFORMATION EXCHANGED BETWEEN THE AGC AND THE
R0012 COMPUTER OPERATOR. THE INPUTS TO THE PROGRAM ARE FROM THE KEYBOARD,
R0013 FROM INTERNAL PROGRAMS, AND FROM THE UPLINK.
R0014 THE LANGUAGE OF COMMUNICATION WITH THE PROGRAM IS A PAIR OF WORDS
R0015 KNOWN AS VERB AND NOUN. EACH OF THESE IS REPRESENTED BY A 2 CHARACTER
R0016 DECIMAL NUMBER. THE VERB CODE INDICATES WHAT ACTION IS TO BE TAKEN, THE
R0017 NOUN CODE INDICATES TO WHAT THIS ACTION IS APPLIED. NOUNS USUALLY
R0018 REFER TO A GROUP OF ERASABLE REGISTERS.

R0020 VERBS ARE GROUPED INTO DISPLAYS, LOADS, MONITORS (DISPLAYS THAT ARE
R0021 UPDATED ONCE PER SECOND), SPECIAL FUNCTIONS, AND EXTENDED VERBS (THESE
R0022 ARE OUTSIDE OF THE DOMAIN OF PINBALL AND CAN BE FOUND UNDER LOG SECTION
R0023 'EXTENDED VERBS').
R0024 A LIST OF VERBS AND NOUNS IS GIVEN IN LOG SECTION 'ASSEMBLY AND
R0025 OPERATION INFORMATION'.
R0026 CALLING SEQUENCES-

R0027 KEYBOARD'
R0028 EACH DEPRESSION OF A MAIN (NAVIGATION) KEYBOARD BUTTON ACTIVATES
R0029 INTERRUPT KEYRUPT1 (KEYRUPT2) AND PLACES THE 5 BIT KEY CODE INTO
R00291 CHANNEL 15 (CHANNEL 16). KEYRUPT1 (KEYRUPT2) PLACES THE KEY
R0030 CODE INTO MPAC, ENTERS AN EXECUTIVE REQUEST FOR THE KEYBOARD AND DISPLAY
R0031 PROGRAM (AT 'CHARIN'), AND EXECUTES A RESUME.

R0032 UPLINK'
R0033 EACH WORD RECEIVED BY THE UPLINK ACTIVATES INTERRUPT UPRUPT WHICH
R0034 PLACES THE 5 BIT KEY CODE INTO MPAC, ENTERS AN EXECUTIVE REQUEST FOR THE
R0035 KEYBOARD AND DISPLAY PROGRAM (AT 'CHARIN') AND EXECUTES A RESUME.

R0036 INTERNAL PROGRAMS'
R0037 INTERNAL PROGRAMS CALL PINBALL AT 'NVSUB' WITH THE DESIRED VERB/NOUN
R0038 CODE IN A (LOW 7 BITS FOR NOUN, NEXT 7 BITS FOR VERB). DETAILS
R0039 DESCRIBED ON REMARKS CARDS JUST BEFORE 'NVSUB' AND 'NVSWAIT' (SEE
R0040 SYMBOL TABLE FOR PAGE NUMBERS).
R0045 NORMAL EXIT MODES-

R0048 IF PINBALL WAS CALLED BY EXTERNAL ACTION, THERE ARE FOUR EXITS'
R004605 1) ALL BUT (2), (3), AND (4) EXIT DIRECTLY TO ENDOPJOB.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 2 E0 S3

R00461 2) EXTENDED VERBS GO TO THE EXTENDED VERB PAN AS PART OF THE
R004615 PINBALL EXECUTIVE JOB WITH PRIORITY 30000. IT IS THE
R00462 RESPONSIBILITY OF THE EXTENDED VERB CALLED TO EVENTUALLY
R00463 CHANGE PRIORITY (IF NECESSARY) AND DO AN ENDJOB.
R004835 ALSO PINBALL IS A NOVAC JOB. EBANK SET FOR COMMON.
R00484 3) VERB 37. CHANGE OF PROGRAM (MAJOR MODE) CALLS 'V37' IN THE
R00485 SERVICE ROUTINES AS PART OF THE PINBALL EXEC JOB WITH Prio
R00466 30000. THE NEW PROGRAM CODE (MAJOR MODE) IS LEFT IN A.
R00487 4) KEY RELEASE BUTTON CALLS 'PINBRNCH' IN THE DISPLAY INTERFACE
R00488 ROUTINES AS PART OF THE PINBALL EXEC JOB WITH Prio 30000 IF
R00469 THE KEY RELEASE LIGHT IS OFF AND 'CADRSTOR' IS NOT +0.

R0047 IF PINBALL WAS CALLED BY INTERNAL PROGRAMS, EXIT FROM PINBALL IS BACK
R0048 TO CALLING ROUTINE. DETAILS DESCRIBED IN REMARKS CARDS JUST BEFORE
R0049 'NVSUB' AND 'NVSWAIT' (SEE SYMBOL TABLE FOR PAGE NUMBERS).
R0050 ALARM OR ABORT EXIT MODES-

R0051 EXTERNAL INITIATION'
R0052 IF SOME IMPROPER SEQUENCE OF KEY CODES IS DETECTED, THE OPERATOR
R0053 ERROR LIGHT IS TURNED ON AND EXIT IS TO 'ENDJOB'.

R0054 INTERNAL PROGRAM INITIATION'
R0055 IF AN ILLEGAL V/N COMBINATION IS ATTEMPTED, AN ABORT IS CAUSED
R0058 (WITH OCTAL 01501).
R00561 IF A SECOND ATTEMPT IS MADE TO GO TO SLEEP IN PINBALL, AN ABORT IS
R00562 CAUSED (WITH OCTAL 01206). THERE ARE TWO WAYS TO GO TO SLEEP IN PINBALL'
R00563 1) ENDIDLE OR OATAWAIT.
R00564 2) NVSWAIT, PRENVBSY, OR NVSUBSY.

R0057 CONDITIONS LEADING TO THE ABOVE ARE DESCRIBED IN FORTHCOMING MIT/IL
R0058 E-REPORT DESCRIBING KEYBOARD AND DISPLAY OPERATION FOR 276.
R0059 OUTPUT-

R0060 INFORMATION TO BE SENT TO THE DISPLAY PANEL IS LEFT IN THE 'DSPTAB'
R0061 BUFFERS REGISTERS (UNDER EXEC CONTROL). 'DSPOUT' (A PART OF T4RUPT)
R0062 HANDLES THE PLACING OF THE 'DSPTAB' INFORMATION INTO OUTPUT CHANNEL 10
R0063 IN INTERRUPT.
R0064 ERASABLE INITIALIZATION-

R0065 FRESH START AND RESTART INITIALIZE THE NECESSARY E REGISTERS FOR
R0066 PINBALL IN 'STARTSUB'. REGISTERS ARE: DSPTAB BUFFER, CADRSTOR,
R0067 RECRET, CLPASS, DSPLOCK, MONSAVE, MONSAVE1, VERBREG, NOUNREG, DSPLIST,
R0068 DSPCOUNT, NOUT.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 3 E0 83

R0089 A COMPLETE LIST OF ALL THE ERASABLES (BOTH RESERVED AND TEMPORARIES) FOR
R0070 PINBALL IS GIVEN BELOW.
R0071 THE FOLLOWING ARE OF GENERAL INTEREST.

R0072 REMARKS CARDS PRECEDE THE REFERENCED SYMBOL DEFINITION. SEE SYMBOL
R0073 TABLE TO FIND APPROPRIATE PAGE NUMBERS.

R0074 NVSUB CALLING POINT FOR INTERNAL USE OF PINBALL.
R0075 OF RELATED INTEREST NVSEWAIT
R0076 NVSEBUSY
R0077 PRENVBSY

R0083 ENDIDLE ROUTINE FOR INTERNAL PROGRAMS WISHING TO GO TO SLEEP WHILE
R0084 AWAITING OPERATORS RESPONSE.

R00851 DSPM ROUTINE BY WHICH AN INTERNAL PROGRAM MAY DISPLAY A DECIMAL
R00852 PROGRAM CODE (MAJOR MODE) IN THE PROGRAM (MAJOR MODE) LIGHTS.
R008525 (DSPM DOES NOT DISPLAY DIRECTLY BUT ENTERS EXEC REQUEST
R008527 FOR DSPMJOB WITH Prio 30000 AND RETURNS TO CALLER.)

R00853 BLANKSUB ROUTINE BY WHICH AN INTERNAL PROGRAM MAY BLANK ANY
R00854 COMBINATION OF THE DISPLAY REGISTERS R1, R2, R3.

R00855 JAMTERM ROUTINES BY WHICH AN INTERNAL PROGRAM MAY PERFORM THE
R00858 JAMPROC TERMINATE (V 34) OR PROCEED (V 33) FUNCTION.

R0086 MONITOR VERBS FOR PERIODIC (1 PER SEC) DISPLAY.

R00861 PLEASE PERFORM, PLEASE MARK SITUATIONS
R00862 REMARKS DESCRIBING HOW AN INTERNAL ROUTINE SHOULD HANDLE
R00863 THESE SITUATIONS CAN BE FOUND JUST BEFORE 'NVSUB' (SEE
R00864 SYMBOL TABLE FOR PAGE NUMBER).

R0087 THE NOUN TABLE FORMAT IS DESCRIBED ON A PAGE OF REMARKS CARDS JUST
R0088 BEFORE 'DSPMJC' (SEE SYMBOL TABLE FOR PAGE NUMBER).

R0089 THE NOUN TABLES THEMSELVES ARE FOUND IN LOG SECTION 'PINBALL NOUN
R00891 TABLES'.
R0090 FOR FURTHER DETAILS ABOUT OPERATION OF THE KEYBOARD AND DISPLAY SYSTEM
R0091 PROGRAM, SEE THE MISSION PLAN AND/OR MIT/IL E-2129
R0092 DESCRIBING KEYBOARD AND DISPLAY OPERATION FOR 278.
R0150 THE FOLLOWING QUOTATION IS PROVIDED THROUGH THE COURTESY OF THE AUTHORS.

R0151 "IT WILL BE PROVED TO THY FACE THAT THOU HAST MEN ABOUT THEE THAT



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 4 E0 S3

R0152 USUALLY TALK OF A NOUN AND A VERB, AND SUCH ABOMINABLE WORDS AS NO
R0153 CHRISTIAN EAR CAN ENDURE TO HEAR."

R0154 HENRY 8, ACT 2, SCENE 4
R0155 THE FOLLOWING ASSIGNMENTS FOR PINBALL ARE MADE ELSEWHERE
R0156 RESERVED FOR PINBALL EXECUTIVE ACTION

R0157	DSPCOUNT	ERASE		DISPLAY POSITION INDICATOR
R0158	DECBRNCH	ERASE		+DEC, - DEC, OCT INDICATOR
R0159	VERBREG	ERASE		VERB CODE
R0180	NOUNREG	ERASE		NOUN CODE
R0181	XREG	ERASE		R1 INPUT BUFFER
R0182	YREG	ERASE		R2 INPUT BUFFER
R0183	ZREG	ERASE		R3 INPUT BUFFER
R0184	XREGCLP	ERASE		LO PART OF XREG (FOR DEC CONV ONLY)
R0185	YREGCLP	ERASE		LO PART OF YREG (FOR DEC CONV ONLY)
R0188	HITEMOUT =	YREGCLP		TEMP FOR DISPLAY OF HRS, MIN, SEC
R0187				MUST = LOTEMOUT-1.
R0188	ZREGCLP	ERASE		LO PART OF ZREG (FOR DEC CONV ONLY)
R0189	LOTEMOUT =	ZREGCLP		TEMP FOR DISPLAY OF HRS, MIN, SEC
R0170				MUST = HITEMOUT+1.
R0171	MODREG	ERASE		MODE CODE
R0172	DSPLOCK	ERASE		KEYBOARD/SUBROUTINE CALL INTERLOCK
R0173	REQRET	ERASE		RETURN REGISTER FOR LOAD
R0174	LOADSTAT	ERASE		STATUS INDICATOR FOR LOADTST
R0175	CLPASS	ERASE		PASS INDICATOR CLEAR
R0176	NOUT	ERASE		ACTIVITY COUNTER FOR DSPTAB
R0177	NOUNCADR	ERASE		MACHINE CADR FOR NOUN
R0178	MONSAVE	ERASE		N/V CODE FOR MONITOR. (= MONSAVE1-1)
R0179	MONSAVE1	ERASE		NOUNCADR FOR MONITOR(MATBS) =MONSAVE +1
R01795	MONSAVE2	ERASE		NVMONOPT OPTIONS
R0180	DSPTAB	ERASE	+13D	0-10, DISPLAY PANEL BUFFER. 11-13, C RELAYS
R0181	CADRSTOR	ERASE		ENDIDLE STORAGE
R0182	NVQTEM	ERASE		NVSUB STORAGE FOR CALLING ADDRESS
R0183				MUST = NVENKTEM-1
R0184	NVENKTEM	ERASE		NVSUB STORAGE FOR CALLING BANK
R0185				MUST = NVQTEM+1
R0186	VERBSAVE	ERASE		NEEDED FOR RECYCLE
R0187	DSPLIST	ERASE		WAITING REG FOR DSP SYST INTERNAL USE
R0188	EXTVACT	ERASE		EXTENDED VERB ACTIVITY INTERLOCK
R0189	DSPTM1	ERASE	+2	BUFFER STORAGE AREA 1 (MOSTLY FOR TIME)
R0190	DSPTM2	ERASE	+2	BUFFER STORAGE AREA 2 (MOSTLY FOR DEG)
R0191	END OF ERASABLES RESERVED FOR PINBALL EXECUTIVE ACTION			
R0192	TEMPORARIES FOR PINBALL EXECUTIVE ACTION			



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 5 Pg 33

R0193	DSEXIT	=	INTB15+	RETURN FOR DSPIN
R0194	EXITEM	=	INTB15+	RETURN FOR SCALE FACTOR ROUTINE SELECT
R0195	BLANKRET	=	INTB15+	RETURN FOR 2BLANK
R0196	WRDRST	=	INTBIT15	RETURN FOR 5BLANK
R0197	WRDRST	=	INTBIT15	RETURN FOR DSPWD
R0198	DECRST	=	INTBIT15	RETURN FOR PUTCOM(DEC LOAD)
R0199	21/22REG	=	INTBIT15	TEMP FOR CHARIN
R0200	UPDATRET	=	POLISH	RETURN FOR UPDATNN, UPDATVB
R0201	CHAR	=	POLISH	TEMP FOR CHARIN
R0202	ERRCNT	=	POLISH	COUNTER FOR ERROR LIGHT RESET
R0203	DECCOUNT	=	POLISH	COUNTER FOR SCALING AND DISPLAY (DEC)
R0204	SNON	=	VBUP	TEMP FOR +, - ON
R0205	NOUNTEM	=	VBUP	COUNTER FOR MIXNOUN FETCH
R0206	DISTEM	=	VBUP	COUNTER FOR OCTAL DISPLAY VERBS
R0207	DECTEM	=	VBUP	COUNTER FOR FETCH (DEC DISPLAY VERBS)
R0208	SNOFF	=	VBUP +1	TEMP FOR +, - ON
R0209	NVTEMP	=	VBUP +1	TEMP FOR NVSUB
R0210	SPTMP1	=	VBUP +1	STORAGE FOR SF CONST HI PART(=SPTMP2-1)
R0211	HITEMIN	=	VBUP +1	TEMP FOR LOAD OF HRS, MIN, SEC
R0212				MUST = LOITEMIN-1.
R0213	CODE	=	VBUP +2	FOR DSPIN
R0214	SPTMP2	=	VBUP +2	STORAGE FOR SF CONST LO PART(=SPTMP1+1)
R0215	LOITEMIN	=	VBUP +2	TEMP FOR LOAD OF HRS, MIN, SEC
R0216				MUST = HITEMIN+1.
R0217	MIXTEMP	=	VBUP +3	FOR MIXNOUN DATA
R0218	SIGNRET	=	VBUP +3	RETURN FOR +, - ON
R0219	ALSO MIXTEMP+1 = VBUP+4, MIXTEMP+2 = VBUP+5.			
R0220	ENTRET	=	DOTINC	EXIT FROM ENTER
R0221	WDONT	=	DOTRET	CHAR COUNTER FOR DSPWD
R0222	INREL	=	DOTRET	INPUT BUFFER SELECTOR (X,Y,Z, REG)
R0223	DSPMMTEM	=	MATINC	DSPCOUNT SAVE FOR DSPMM
R0224	MIXBR	=	MATINC	INDICATOR FOR MIXED OR NORMAL NOUN
R0225	TEM1	ERASE		EXEC TEMP
R0226	DSREL	=	TEM1	REL ADDRESS FOR DSPIN
R0227	TEM2	ERASE		EXEC TEMP
R0228	DSMAG	=	TEM2	MAGNITUDE STORE FOR DSPIN
R0229	IDADDTEM	=	TEM2	MIXNOUN INDIRECT ADDRESS STORAGE
R0230	TEM3	ERASE		EXEC TEMP
R0231	COUNT	=	TEM3	FOR DSPIN



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 6 E0 S3

R0232	TEM4	ERASE	EXEC TEMP
R0233	LSTPTR	= TEM4	LIST POINTER FOR GRABUSY
R0234	RELRET	= TEM4	RETURN FOR RELDSP
R0235	PREERET	= TEM4	RETURN FOR PREEDSP
R0236	DSPEDRET	= TEM4	RETURN FOR DSPSIGN
R0237	SEPSCRET	= TEM4	RETURN FOR SEPSEC
R0238	SEPMNRET	= TEM4	RETURN FOR SEPMIN
R0239	TEM5	ERASE	EXEC TEMP
R0240	NOUNADD	= TEM5	TEMP STORAGE FOR NOUN ADDRESS
R0241	NNADTEM	ERASE	TEMP FOR NOUN ADDRESS TABLE ENTRY
R0242	NNTYPTM	ERASE	TEMP FOR NOUN TYPE TABLE ENTRY
R0243	IDAD1TEM	ERASE	TEMP FOR INDIR ADDRESS TABLE ENTRY(MIXNN)
R0244			MUST = IDAD2TEM-1, = IDAD3TEM-2.
R0245	IDAD2TEM	ERASE	TEMP FOR INDIR ADDRESS TABLE ENTRY(MIXNN)
R0246			MUST = IDAD1TEM+1, = IDAD3TEM-1.
R0247	IDAD3TEM	ERASE	TEMP FOR INDIR ADDRESS TABLE ENTRY(MIXNN)
R0248			MUST = IDAD1TEM+2, = IDAD2TEM+1.
R0249	RUTMTEM	ERASE	TEMP FOR SF ROUT TABLE ENTRY(MIXNN ONLY)
R0250	END OF TEMPORARIES FOR PINBALL EXECUTIVE ACTION		
R02501	ADDITIONAL TEMPORARIES FOR PINBALL EXECUTIVE ACTION		
R02502	MPAC, THRU MPAC +6		
R02503	RUP, +1, +2		
R02504	RUP2, +1, +2		
R02506	MPTEMP		
R02507	ADDRWD		
R02509	END OF ADDITIONAL TEMPS FOR PINBALL EXEC ACTION		
R0251	RESERVED FOR PINBALL INTERRUPT ACTION		
R0252	DSPONT	ERASE	COUNTER FOR DSPOUT
R0253	UPLCK	ERASE	BIT1 = UPLINK INTERLOCK (ACTIVATED BY
A0254	RECEPTION OF A BAD MESSAGE IN UPLINK)		
R0255	END OF ERASABLES RESERVED FOR PINBALL INTERRUPT ACTION		
R0258	TEMPORARIES FOR PINBALL INTERRUPT ACTION		
R0257	KEYTEMP1	= WAITEXIT	TEMP FOR KEYRUPT, UPRUPT
R0258	DSRUPTM	= WAITEXIT	TEMP FOR DSPOUT
R0259	KEYTEMP2	= RUPTAGN	TEMP FOR KEYRUPT, UPRUPT
R0260	END OF TEMPORARIES FOR PINBALL INTERRUPT ACTION		



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 7 E0 S3

R0261 THE INPUT CODES ASSUMED FOR THE KEYBOARD ARE,
R0262 0 10000
R0263 1 00001
R0264 9 01001
R0265 VERB 10001
R0266 ERROR RES10010
R0267 KEY RLSE 11001
R0268 + 11010
R0269 - 11011
R0270 ENTER 11100
R0271 CLEAR 11110
R0272 NOUN 11111
R0273 OUTPUT FORMAT FOR DISPLAY PANEL. SET OUT0 TO AAAABCCCCDDDDDD.
R0274 A-S SELECT A RELAYWORD. THIS DETERMINES WHICH PAIR OF CHARACTERS ARE
R0275 ENERGIZED.
R0276 B FOR SPECIAL RELAYS SUCH AS SIGNS ETC.
R0277 C-S 5 BIT RELAY CODE FOR LEFT CHAR OF PAIR SELECTED BY RELAYWORD
R0278 D-S 5 BIT RELAY CODE FOR RIGHTCHAR OF PAIR SELECTED BY RELAYWORD.

R0279 THE PANEL APPEARS AS FOLLOWS,
R0280 MD1 MD2 (MAJOR MODE)
R0281 VD1 VD2 (VERB) ND1 ND2 (NOUN)
R0282 R1D1 R1D2 R1D3 R1D4 R1D5 (R1)
R0283 R2D1 R2D2 R2D3 R2D4 R2D5 (R2)
R0284 R3D1 R3D2 R3D3 R3D4 R3D5 (R3)

R0285 EACH OF THESE IS GIVEN A DSPCOUNT NUMBER FOR USE WITHIN COMPUTATION ONLY
R0286 MD1 25 R2D1 11 ALL ARE OCTAL
R0287 MD2 24 R2D2 10
R0288 VD1 23 R2D3 7
R0289 VD2 22 R2D4 6
R0290 ND1 21 R2D5 5
R0291 ND2 20 R3D1 4
R0292 R1D1 18 R3D2 3
R0293 R1D2 15 R3D3 2
R0294 R1D3 14 R3D4 1
R0295 R1D4 13 R3D5 0
R0296 R1D5 12
R0297 THERE IS AN 11 REGISTER TABLE (DSPTAB) FOR THE DISPLAY PANEL.

R0298 DSPTAB RELAYWD BIT11 BITS 10-6 BITS 5-1
R0299 RELADD
R0300 10 1011 MD1 (25) MD2 (24)
R0301 9 1010 VD1 (23) VD2 (22)
R0302 6 1001 ND1 (21) ND2 (20)
R0303 7 1000 R1D1 (18)



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 8 E0 S3

R0304	6	0111	+R1	R1D2 (15)	R1D3 (14)
R0305	5	0110	-R1	R1D4 (13)	R1D5 (12)
R0306	4	0101	+R2	R2D1 (11)	R2D2 (10)
R0307	3	0100	-R2	R2D3 (7)	R2D4 (6)
R0308	2	0011		R2D5 (5)	R3D1 (4)
R0309	1	0010	+R3	R3D2 (3)	R3D3 (2)
R0310	0	0001	-R3	R3D4 (1)	R3D5 (0)
R0311		0000	NO RELAYWORD		
R0312	THE 5 BIT OUTPUT RELAY CODES ARE				
R0313	BLANK	00000			
R0314	0	10101			
R0315	1	00011			
R0316	2	11001			
R0317	3	11011			
R0318	4	01111			
R0319	5	11110			
R0320	6	11100			
R0321	7	10011			
R0322	8	11101			
R0323	9	11111			
R03231	OUTPUT BITS USED BY PINBALL				
R03232	KEY RELEASE LIGHT				- BIT 5 OF CHANNEL 11
R03233	VERB/NOIN FLASH				- BIT 6 OF CHANNEL 11
R03234	OPERATOR ERROR LIGHT				- BIT 7 OF CHANNEL 11



20'35 OCT. 28, 1968 KOOLADZ .069 PAGE 310

USER'S PAGE NO. 9 E0 S3

L PINBALL GAME BUTTONS AND LIGHTS

P0324 START OF EXECUTIVE SECTION OF PINBALL

START OF EXECUTIVE SECTION OF PINBALL			
0325			
032501	REP	1	40,2000
032502			40,2000
			40,2000

BANK	
40	
SSLOC	PINBALL1
BANK	

03255 REF 1

COUNT 40/PIN

0330	REF	14	LAST	299	40,2000	3 4712 0	CHARIN	CAP	ONE
0331	REF	2	LAST	188	40,2001	57=012 0		XCH	DSBLOCK
0332	REF	1			40,2002	54 115 0		TS	21/22RPT
03321	REF	2	LAST	188	40,2003	11=042 1		CCS	CADRSTOR
03322					40,2004	0 2008 0		TC	+2
03323	REF	1			40,2005	0 2013 1		TC	CHARIN2
03324	REF	1			40,2006	4 2057 0		CS	ELACODE1
03325	REF	59	LAST	301	40,2007	6 0154 1		AD	MPAC
03326					40,2010	0 0006 1		EXTEND	
03327	REF	2	LAST	310	40,2011	1 2013 0		BZF	CHARIN2
03328	REF	1			40,2012	0 4410 0		TC	RELDSPON
0333	REF	60	LAST	310	40,2013	56 154 1	CHARIN2	XCH	MPAC
0334	REF	1			40,2014	54 117 1		TS	CHAR
0335	REF	77	LAST	299	40,2015	50 000 1		INDEX	A
0336					40,2016	0 2017 0		TC	+1
0337	REF	1			40,2017	0 3335 1		TC	CHARALRM
0338	REF	1			40,2020	0 2076 1		TC	NUM
0339	REF	2	LAST	310	40,2021	0 2076 1		TC	NUM
0340	REF	3	LAST	310	40,2022	0 2076 1		TC	NUM
0341	REF	4	LAST	310	40,2023	0 2076 1		TC	NUM
0342	REF	5	LAST	310	40,2024	0 2076 1		TC	NUM
0343	REF	6	LAST	310	40,2025	0 2076 1		TC	NUM
0344	REF	7	LAST	310	40,2026	0 2076 1		TC	NUM
0345	REF	1			40,2027	0 2062 1		TC	89TEST
0346	REF	2	LAST	310	40,2030	0 2062 1		TC	89TEST
0347	REF	2	LAST	310	40,2031	0 3335 1		TC	CHARALRM
0348	REF	3	LAST	310	40,2032	0 3335 1		TC	CHARALRM
0349	REF	4	LAST	310	40,2033	0 3335 1		TC	CHARALRM
0350	REF	5	LAST	310	40,2034	0 3335 1		TC	CHARALRM
0351	REF	6	LAST	310	40,2035	0 3335 1		TC	CHARALRM
0352	REF	7	LAST	310	40,2036	0 3335 1		TC	CHARALRM
0353	REF	8	LAST	310	40,2037	0 2074 0		TC	NUM
0354	REF	1			40,2040	0 2255 1		TC	VERB
0355	REF	1			40,2041	0 3504 0		TC	ERROR
0356	REF	8	LAST	310	40,2042	0 3335 1		TC	CHARALRM
0357	REF	9	LAST	310	40,2043	0 3335 1		TC	CHARALRM
0358	REF	10	LAST	310	40,2044	0 3335 1		TC	CHARALRM
0359	REF	11	LAST	310	40,2045	0 3335 1		TC	CHARALRM
0360	REF	12	LAST	310	40,2046	0 3335 1		TC	CHARALRM
0361	REF	13	LAST	310	40,2047	0 3335 1		TC	CHARALRM
0362	REF	1			40,2050	0 3362 0		TC	VBRELDSP

BLOCK DISPLAY SYST
MAKE DSP SYST BUSY, BUT SAVE OLD
C(DSPLOC) FOR ERROR LIGHT RESET.
ALL KEYS EXCEPT ER TURN ON KR LITE IF
CADSTROR IS FULL. THIS REMINDS OPERATOR
TO RE-ESTABLISH A FLASHING DISPLAY
WHICH HE HAS OBSCURED WITH DISPLAYS OF
HIS OWN (SEE REMARKS PRECEDING ROUTINE
VBRELDSP).

INPUT CODE	FUNCTION
0	
1	
2	
3	
4	
5	
6	
7	
10	8
11	9
12	
13	
14	
15	
16	
17	
20	0
21	VERR
22	ERROR LIGHT RESET
23	
24	
25	
26	
27	
30	
31	KEY RELEASE



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 10 E0 S4

0363	REF	1		40,2051	0 2310 1	TC	POSGN	32	+
0364	REF	1		40,2052	0 2275 0	TC	NEGSGN	33	-
0365	REF	1		40,2053	0 2060 0	TC	ENTERJMP	34	ENTER
0366	REF	14	LAST 310	40,2054	0 3335 1	TC	CHARALRM	35	
0367	REF	1		40,2055	0 2370 1	TC	CLEAR	36	CLEAR
0368	REF	1		40,2056	0 2271 1	TC	NOUN	37	NOUN
03685				40,2057	00022 1	ELRCODE ₁ OCT	22		
0369	REF	15	LAST 261	40,2060	0 4574 0	ENTERJMP TC	POSTJUMP		
0370	REF	1		40,2061	62002 1	CADR	ENTER		
0371	REF	3	LAST 166	40,2062	10 777 1	69TEST CCS	DSPCOUNT		
0372				40,2063	0 2067 1	TC	+4	+	
0373				40,2064	0 2067 1	TC	+3	+0	
0374	REF	22	LAST 301	40,2065	0 5112 0	TC	ENDOFJOB	-	BLOCK DATA IN IF DSPCOUNT IS - OR -0
0375	REF	23	LAST 311	40,2066	0 5112 0	TC	ENDOFJOB	-0	
0376	REF	2	LAST 32	40,2067	3 6214 0	CAP	THREE		
0377	REF	1		40,2070	7 1000 1	MASK	DECBRNCH		
0376	REF	76	LAST 310	40,2071	10 000 0	CCS	A		
0379	REF	9	LAST 310	40,2072	0 2076 1	TC	NUM		IF DECBRNCH IS +, 8 OR 9 OK
0380	REF	15	LAST 311	40,2073	0 3335 1	TC	CHARALRM		IF DECBRNCH IS +0, REJECT 6 OR 9
R0361	NUM ASSEMBLES OCTAL 3 BITS AT A TIME. FOR DECIMAL IT CONVERTS INCOMING								
R0362	WORD AS A FRACTION, KEEPING RESULTS TO DP.								
R0363	OCTAL RESULTS ARE LEFT IN XREG, YREG, OR ZREG. HI PART OF DEC IN XREG,								
R0364	YREG, ZREG. THE LOW PARTS IN XREGLP, YREGLP, OR ZREGLP)								
R0365	DECBRNCH IS LEFT AT +0 FOR OCT, +1 FOR + DEC, +2 FOR - DEC.								
R0366	IF DSPCOUNT WAS LEFT -, NO MORE DATA IS ACCEPTED.								
0367	REF	31	LAST 301	40,2074	3 4714 1	CAP	ZERO		
0368	REF	2	LAST 310	40,2075	54 117 1	TS	CHAR		
0369	REF	4	LAST 311	40,2076	10 777 1	NUM CCS	DSPCOUNT		
0390				40,2077	0 2103 1	TC	+4	+	
0391				40,2100	0 2103 1	TC	+3	+0	
0392				40,2101	0 2102 0	TC	+1	-	BLOCK DATA IN IF DSPCOUNT IS -
0393	REF	24	LAST 311	40,2102	0 5112 0	TC	ENDOFJOB	-0	
0394	REF	1		40,2103	0 2225 0	TC	GETINREL		
0395	REF	2	LAST 166	40,2104	11-015 0	CCS	CLPASS		IF CLPASS IS + OR +0, MAKE IT +0.
0396	REF	32	LAST 311	40,2105	3 4714 1	CAP	ZERO		
0397	REF	3	LAST 311	40,2106	55-015 0	TS	CLPASS		
0398				40,2107	0 2110 0	TC	+1		
0399	REF	3	LAST 311	40,2110	50 117 0	INDEX	CHAR		
0400	REF	2	LAST 131	40,2111	3 4072 0	CAP	RELTAB		
0401	REF	2	LAST 227	40,2112	7 4362 0	MASK	LOWS		
0402	REF	1		40,2113	54 124 1	TS	CODE		
0403	REF	5	LAST 311	40,2114	3 0777 0	CA	DSPCOUNT		
0404	REF	1		40,2115	54 143 0	TS	COUNT		
0405	REF	1		40,2116	0 3225 1	TC	DSPIN		



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 11 E0 S4

0406	REF	3	LAST	311	40,2117	3 6214 0	CAP	THREE	
0407	REF	2	LAST	311	40,2120	7 1000 1	MASK	DECBRNCH	
0408	REF	79	LAST	311	40,2121	10 000 0	CCS	A	+0, OCTAL. +1, + DEC. +2, - DEC.
0409	REF	1			40,2122	0 2133 1	TC	DECTOBIN	+
0410	REF	1			40,2123	50 137 1	INDEX	INREL	+0 OCTAL
0411	REF	2	LAST	166	40,2124	57*001 1	XCH	VERBREG	
0412	REF	1			40,2125	54 022 0	TS	CYL	
0413	REF	2	LAST	312	40,2126	4 0022 0	CS	CYL	
0414	REF	3	LAST	312	40,2127	4 0022 0	CS	CYL	
0415	REF	4	LAST	312	40,2130	56 022 1	XCH	CYL	
0416	REF	4	LAST	311	40,2131	6 0117 0	AD	CHAR	
0417	REF	1			40,2132	0 2150 1	TC	ENDMTST	
0418	REF	2	LAST	312	40,2133	50 137 1	DECTOBIN INDEX	INREL	
0419	REF	3	LAST	312	40,2134	57*001 1	XCH	VERBREG	
0420	REF	61	LAST	310	40,2135	54 154 0	TS	MPAC	SUM X 2EXP-14 IN MPAC
0421	REF	33	LAST	311	40,2136	3 4714 1	CAP	ZERO	
0422	REF	62	LAST	312	40,2137	54 155 1	TS	MPAC	+1
0423	REF	2	LAST	167	40,2140	3 4377 0	CAP	TEN	10 X 2EXP-14
0424	REF	3	LAST	286	40,2141	0 7258 1	TC	SHORTMP	10 SUM X 2EXP-26 IN MPAC, MPAC+1
0425	REF	63	LAST	312	40,2142	56 155 0	XCH	MPAC	+1
0426	REF	5	LAST	312	40,2143	6 0117 0	AD	CHAR	
0427	REF	64	LAST	312	40,2144	54 155 1	TS	MPAC	+1
0428	REF	2	LAST	312	40,2145	0 2150 1	TC	ENDMTST	NO OP
0429	REF	65	LAST	312	40,2146	26 154 0	ADS	MPAC	OF MUST BE 5TH CHAR
0430	REF	1			40,2147	0 2166 1	TC	DECEND	
0431	REF	3	LAST	312	40,2150	50 137 1	ENDMTST INDEX	INREL	
0432	REF	4	LAST	312	40,2151	55*001 0	TS	VERBREG	
0433	REF	6	LAST	311	40,2152	4 0777 1	CS	DSPCOUNT	
0434	REF	4	LAST	312	40,2153	50 137 1	INDEX	INREL	
0435	REF	1			40,2154	6 2216 0	AD	CRITCON	
0436					40,2155	0 0006 1	EXTEND		
0437	REF	1			40,2156	1 2160 0	BZF	ENDNUM	-0, DSPCOUNT = CRITCON
0438	REF	1			40,2157	0 2213 0	TC	MORNUM	- , DSPCOUNT G/ CRITCON
0439	REF	4	LAST	312	40,2160	3 6214 0	ENDNUM	CAP	THREE
0440	REF	3	LAST	312	40,2161	7 1000 1	MASK	DECBRNCH	
0441	REF	60	LAST	312	40,2162	10 000 0	CCS	A	
0442	REF	2	LAST	312	40,2163	0 2166 1	TC	DECEND	
0443	REF	7	LAST	312	40,2164	4 0777 1	ENDALL	CS	DSPCOUNT
0444	REF	2	LAST	312	40,2165	0 2214 1	TC	MORNUM	+1
0445	REF	15	LAST	310	40,2166	4 4712 0	DECEND	CS	ONE
0446	REF	5	LAST	312	40,2167	6 0137 1	AD	INREL	
0447					40,2170	0 0006 1	EXTEND		
0448	REF	1			40,2171	6 2164 0	BZMP	ENDALL	IF INREL=0,1(VBREG,NNREG), LEAVE WHOLE
0449	REF	1			40,2172	0 7052 1	TC	DMP	IF INREL=2,3,4(R1,R2,R3), CONVERT TO FRAC
A0450									MULT SUM X 2EXP-26 IN MPAC, MPAC+1 BY
0451	REF	1			40,2173	02223 0	ADRES	DECON	2EXP14/10EXP5. GIVES(SUM/10EXP5)X2EXP-14
0452	REF	5	LAST	312	40,2174	3 6214 0	CAP	THREE	IN MPAC, +1, +2.
0453	REF	4	LAST	312	40,2175	7 1000 1	MASK	DECBRNCH	
0454	REF	61	LAST	312	40,2176	50 000 1	INDEX	A	
0455					40,2177	0 2177 1	TC	+0	



L PINBALL GAME BUTTONS AND LIGHTS

USER=8 PAGE NO. 12 E0 84

0456	REP	1		40,2200	0 2204 0	TC	+DECSN		
0457				40,2201	0 0006 1	EXTEND		- CASE	
0458	REP	66	LAST	312	40,2202	4 0156 1	DCS	MPAC	+1
0459	REP	67	LAST	313	40,2203	52 156 1	DXCH	MPAC	+1
0460	REP	68	LAST	313	40,2204	56 156 0	+DECSN	XCH	MPAC +2
0461	REP	6	LAST	312	40,2205	50 137 1	INDEX	INREL	
0462	REP	1			40,2206	55=004 0	TS	XREGCLP	-2
0463	REP	69	LAST	313	40,2207	56 155 0	XCH	MPAC	+1
0464	REP	7	LAST	313	40,2210	50 137 1	INDEX	INREL	
0465	REP	5	LAST	312	40,2211	55=001 0	TS	VERBREG	
0466	REP	2	LAST	312	40,2212	0 2184 0	TC	ENDALL	
0467	REP	8	LAST	312	40,2213	10 777 1	MORNUM	CCS	DSPCOUNT
0468	REP	9	LAST	313	40,2214	54 777 1	TS	DSPCOUNT	DECREMENT DSPCOUNT
0469	REP	25	LAST	311	40,2215	0 5112 0	TC	ENDOFJOB	
0470				40,2216	00022 1	CRITCON	OCT	22	(DEC 18)
0471				40,2217	00020 0		OCT	20	(DEC 18)
0472				40,2220	00012 1		OCT	12	(DEC 10)
0473				40,2221	00005 1		OCT	5	
0474				40,2222	00000 1		OCT	0	
0475				40,2223	05174 0	DECON	2DEC	E-5 B14	2EXP14/10EXP5 = .16364 DEC
0475				40,2224	13281 0				
R0476	GETINREL GETS PROPER DATA REG REL ADDRESS FOR CURRENT C(DSPCOUNT) AND								
R0477	PUTS IN INTO INREL. +0 VERBREG, 1 NOUNREG, 2 XREG, 3 YREG, 4 ZREG.								
0478	REP	10	LAST	313	40,2225	50 777 0	GETINREL	INDEX	DSPCOUNT
0479	REP	1			40,2226	3 2231 0	CAF	INRELTAB	
0480	REP	6	LAST	313	40,2227	54 137 0	TS	INREL	(A TEMP, REG)
0481	REP	36	LAST	301	40,2230	0 0002 0	TC	Q	
0482				40,2231	00004 0	INRELTAB	OCT	4	R3D5 (DSPCOUNT = 0)
0483				40,2232	00004 0		OCT	4	R3D4 = (1)
0484				40,2233	00004 0		OCT	4	R3D3 = (2)
0485				40,2234	00004 0		OCT	4	R3D2 = (3)
0486				40,2235	00004 0		OCT	4	R3D1 = (4)
0487				40,2236	00003 1		OCT	3	R2D5 = (5)
0488				40,2237	00003 1		OCT	3	R2D4 = (6)
0489				40,2240	00003 1		OCT	3	R2D3 = (7)
0490				40,2241	00003 1		OCT	3	R2D2 = (8D)
0491				40,2242	00003 1		OCT	3	R2D1 = (9D)
0492				40,2243	00002 0		OCT	2	R1D5 = (10D)
0493				40,2244	00002 0		OCT	2	R1D4 = (11D)
0494				40,2245	00002 0		OCT	2	R1D3 = (12D)
0495				40,2246	00002 0		OCT	2	R1D2 = (13D)
0496				40,2247	00002 0		OCT	2	R1D1 = (14D)
0497	REP	1			40,2250	0 5640 0	TC	CCSHOLE	NO DSPCOUNT NUMBER = 15D
0498				40,2251	00001 0		OCT	1	ND2 = (16D)



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 13 E0 S4

0499				40,2252	00001 0	OCT	1	
0500				40,2253	00000 1	OCT	0	
0501				40,2254	00000 1	OCT	0	
0502	REP	34	LAST	312	40,2255 3 4714 1	VERB	CAP	ZERO
0503	REP	8	LAST	313	40,2256 55=001 0		TS	VERBREG
0504	REP	2	LAST	188	40,2257 3 4374 0		CAP	VD1
0505	REP	11	LAST	313	40,2260 54 777 1	NVCOM	TS	DSPCOUNT
0506	REP	1			40,2261 0 2502 1		TC	2BLANK
0507	REP	16	LAST	312	40,2262 3 4712 1		CAP	ONE
0508	REP	5	LAST	312	40,2263 55=000 1		TS	DECBRNCH
0509	REP	35	LAST	314	40,2264 3 4714 1		CAP	ZERO
0510	REP	2	LAST	188	40,2265 55=013 0		TS	REGRET
0511	REP	1			40,2266 3 4233 1		CAP	ENDINST
0512	REP	1			40,2267 54 136 1		TS	ENTRET
A0513								
0514	REP	26	LAST	313	40,2270 0 5112 0		TC	ENDOFJOB
0515	REP	36	LAST	314	40,2271 3 4714 1	NOUN	CAP	ZERO
0516	REP	7	LAST	265	40,2272 55=002 0		TS	NOUNREG
0517	REP	1			40,2273 3 4375 1		CAP	ND1
0518	REP	1			40,2274 0 2260 1		TC	NVCOM
0519	REP	1			40,2275 0 2347 0	NEGSGN	TC	SIGNTEST
0520	REP	1			40,2276 0 2334 1		TC	-ON
0521	REP	7	LAST	297	40,2277 3 4711 1		CAP	TWO
0522	REP	9	LAST	313	40,2300 50 137 1	BOTHSGN	INDEX	INREL
0523	REP	26	LAST	253	40,2301 6 4704 0		AD	BIT7
0524	REP	6	LAST	314	40,2302 27=000 1		ADS	DECBRNCH
0525	REP	4	LAST	311	40,2303 11=015 0	FIXCLPAS	CCS	CLPASS
0526	REP	37	LAST	314	40,2304 3 4714 1		CAP	ZERO
0527	REP	5	LAST	314	40,2305 55=015 0		TS	CLPASS
0528					40,2306 0 2307 1		TC	+1
0529	REP	27	LAST	314	40,2307 0 5112 0		TC	ENDOFJOB
0530	REP	2	LAST	314	40,2310 0 2347 0	POSGN	TC	SIGNTEST
0531	REP	1			40,2311 0 2314 0		TC	+ON
0532	REP	17	LAST	314	40,2312 3 4712 1		CAP	ONE
0533	REP	1			40,2313 0 2300 0		TC	BOTHSGN
0534	REP	39	LAST	313	40,2314 22 002 0	+ON	LXCH	0
0535	REP	2	LAST	311	40,2315 0 2225 0		TC	GETINREL
0536	REP	10	LAST	314	40,2316 50 137 1		INDEX	INREL
0537	REP	1			40,2317 3 2342 0		CAP	SGNTAB -2
0538	REP	1			40,2320 54 123 0		TS	SGNOFF
0539	REP	18	LAST	314	40,2321 6 4712 1		AD	ONE
0540	REP	1			40,2322 54 122 1		TS	SGNON
0541	REP	38	LAST	314	40,2323 3 4714 1	SGNCOM	CAP	ZERO
0542	REP	2	LAST	311	40,2324 54 124 1		TS	CODE

ND1 =(17D)
VD2 =(18D)
VD1 =(19D)

SET FOR DEC V/N CODE

SET FOR ENTPAS0
IF DSPALARM OCCURS BEFORE FIRST ENTPAS0
OR NVSUB, ENTRET MUST ALREADY BE SET
TO TC ENDOFJOB

ND1, OCT 21 (DEC 17)

SET DEC COMP BIT TO 1 (IN DECBRNCH)
BIT 5 FOR R1, BIT 4 FOR R2,
BIT 3 FOR R3.
IF CLPASS IS + OR +0, MAKE IT +0.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 14 E0 S4

0543	REF	2	LAST	314	40,2325	56 123 1	XCH	SGNOFF	
0544	REF	1			40,2326	0 3307 0	TC	11DSPIN	
0545	REF	14	LAST	280	40,2327	3 4700 1	CAP	BIT11	
0546	REF	3	LAST	314	40,2330	54 124 1	TS	CODE	
0547	REF	2	LAST	314	40,2331	56 122 0	XCH	SGNCH	
0548	REF	2	LAST	315	40,2332	0 3307 0	TC	11DSPIN	
0549	REF	25	LAST	301	40,2333	0 0001 0	TC	L	
0550	REF	40	LAST	314	40,2334	22 002 0	-CN	LXCH	0
0551	REF	3	LAST	314	40,2335	0 2225 0	TC	GETINREL	
0552	REF	11	LAST	314	40,2336	50 137 1	INDEX	INREL	
0553	REF	2	LAST	314	40,2337	3 2342 0	CAP	SGNTAB	-2
0554	REF	3	LAST	315	40,2340	54 122 1	TS	SGNCH	
0555	REF	19	LAST	314	40,2341	6 4712 1	AD	ONE	
0556	REF	3	LAST	315	40,2342	54 123 0	TS	SGNOFF	
0557	REF	1			40,2343	0 2323 1	TC	SGNCOM	
0558					40,2344	00005 1	SGNTAB	OCT	5
0559					40,2345	00003 1		OCT	3
0560					40,2346	00000 1		OCT	0
0561	REF	41	LAST	315	40,2347	22 002 0	SIGNTST	LXCH	0
0562	REF	6	LAST	312	40,2350	3 6214 0	CAP	THREE	
0563	REF	7	LAST	314	40,2351	7 1000 1	MASK	DECBRNCH	
0564	REF	62	LAST	312	40,2352	10 000 0	CCS	A	
0565	REF	26	LAST	314	40,2353	0 5112 0	TC	ENDOPJOB	
0566	REF	2	LAST	227	40,2354	4 4333 1	CS	R1D1	
0567	REF	1			40,2355	0 2363 0	TC	SGNTST1	
0568	REF	1			40,2356	4 4334 0	CS	R2D1	
0569	REF	2	LAST	315	40,2357	0 2363 0	TC	SGNTST1	
0570	REF	1			40,2360	4 4335 1	CS	R3D1	
0571	REF	3	LAST	315	40,2361	0 2363 0	TC	SGNTST1	
0572	REF	29	LAST	315	40,2362	0 5112 0	TC	ENDOPJOB	
0573	REF	12	LAST	314	40,2363	6 0777 0	SGNTST1	AD	DSPCOUNT
0574					40,2364	0 0006 1	EXTEND		
0575					40,2365	1 2367 0	BZF	+2	
0576	REF	42	LAST	315	40,2366	0 0002 0	TC	0	
0577	REF	26	LAST	315	40,2367	0 0001 0	TC	L	
0578	CLEAR BLANKS WHICH R1, R2, R3 IS CURRENT OR LAST TO BE DISPLAYED(PERTINE								
0579	NT XREG,YREG,ZREG IS CLEARED). SUCCESSIVE CLEARS TAKE CARE OF EACH RX								
0580	L/ RC UNTIL R1 IS DONE. THEN NO FURTHER ACTION								
0581	THE SINGLE COMPONENT LOAD VERBS ALLOW ONLY THE SINGLE RC THAT IS								
0582	APPROPRIATE TO BE CLEARED.								
0583	CLPASS	+0	PASS0, CAN BE BACKED UP						
0584		+NZ	HIPASS, CAN BE BACKED UP						
0585		-NZ	PASS0, CANNOT BE BACKED UP						

ALLOWS +,- ONLY WHEN DSPCOUNT=R1D1,
R2D1, OR R3D1. ALLOWS ONLY FIRST OF
CONSECUTIVE +/- CHARACTERS.
IF LOW2 BITS OF DECBRNCH NOT= 0, SIGN
FOR THIS WORD ALREADY IN. REJECT.

NO MATCH FOUND. SIGN ILLEGAL

MATCH FOUND

SIGN LEGAL

L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 15 EQ S4

```

0586 REF 13 LAST 315 40,2370 10 777 1 CLEAR CCS DSPCOUNT
0587 REF 20 LAST 315 40,2371 6 4712 1 AD ONE
0588 40,2372 0 2374 0 TC +2
0589 REF 21 LAST 316 40,2373 6 4712 1 AD ONE
0590 REF 63 LAST 315 40,2374 50 000 1 INDEX A
0591 REF 2 LAST 313 40,2375 3 2231 0 CAP INRELTAB
0592 REF 12 LAST 315 40,2376 54 137 0 TS INREL
0593 REF 6 LAST 314 40,2377 11=015 0 CCS CLPASS
0594 REF 1 40,2400 0 2408 1 TC CLPASHI
0595 40,2401 0 2403 1 TC +2
0596 40,2402 0 2403 1 TC +1
0597 REF 13 LAST 316 40,2403 3 0137 1 CA INREL
0598 REF 1 40,2404 0 2430 1 TC LEGALTST
0599 REF 1 40,2405 0 2423 0 TC CLEAR1
0600 REF 14 LAST 316 40,2406 10 137 0 CLPASHI CCS INREL
0601 REF 15 LAST 316 40,2407 54 137 0 TS INREL
0602 REF 2 LAST 316 40,2410 0 2430 1 TC LEGALTST
0603 REF 1 40,2411 3 2500 0 CAP DOUBLK +2
0604 REF 3 LAST 314 40,2412 27=013 0 ADS REQRET
0605 REF 16 LAST 316 40,2413 3 0137 1 CA INREL
0606 REF 1 40,2414 54 125 0 TS MIXTEMP
0607 40,2415 0 0008 1 EXTEND
0608 REF 7 LAST 314 40,2416 27=001 0 DIM VERBREG
0609 REF 36 LAST 301 40,2417 0 4555 0 TC BANKCALL
0610 REF 1 40,2420 62337 1 CADR UPDATVB
0611 REF 2 LAST 316 40,2421 3 0125 1 CA MIXTEMP
0612 REF 17 LAST 316 40,2422 54 137 0 TS INREL
0613 REF 1 40,2423 0 2426 0 CLEAR1 TC CLRS
0614 REF 7 LAST 316 40,2424 25=015 1 INCR CLPASS
0615 REF 30 LAST 315 40,2425 0 5112 0 TC ENDOPJOB
0616 REF 43 LAST 315 40,2426 22 002 0 CLRS LXCH Q
0617 REF 1 40,2427 0 2441 1 TC SBLANK +2
0618 REF 2 LAST 229 40,2430 6 7715 0 LEGALTST AD NEG2
0619 REF 64 LAST 316 40,2431 10 000 0 CCS A
0620 REF 44 LAST 316 40,2432 0 0002 0 TC Q
0621 REF 2 LAST 313 40,2433 0 5640 0 TC CSHOLE
0622 REF 31 LAST 316 40,2434 0 5112 0 TC ENDOPJOB
0623 REF 45 LAST 316 40,2435 0 0002 0 TC Q
R0624 SBLANK BLANKS 5 CHAR DISPLAY WORD IN R1, R2, OR R3. IT ALSO ZEROES XREG,
R0625 YREG, OR ZREG. PLACE ANY + DSPCOUNT NUMBER FOR PERTINENT RC INTO DSPCOUNT
R0626 DSPCOUNT IS LEFT SET TO LEFT MOST DSP NUMB FOR RC JUST BLANKED.

0627 REF 14 LAST 316 40,2436 54 777 1 TS DSPCOUNT
0628 REF 46 LAST 316 40,2437 22 002 0 SBLANK LXCH Q
0629 REF 4 LAST 315 40,2440 0 2225 0 TC GETINREL
0630 REF 39 LAST 314 40,2441 3 4714 1 CAP ZERO
0631 REF 18 LAST 316 40,2442 50 137 1 INDEX INREL
0632 REF 8 LAST 316 40,2443 55=001 0 TS VERBREG

```

DO NOT CHANGE DSPCOUNT BECAUSE MAY LATER
FAIL LEGALTST.
MUST SET INREL, EVEN FOR HIPASS.

+
+0 IF CLPASS IS +0 OR -, IT IS PASS0
-

+3 TO - NUMBER. BACKS DATA REQUESTS.

TEMP STORAGE FOR INREL

DECREMENT VERB AND RE-DISPLAY

RESTORE INREL

ONLY IF CLPASS IS + OR +0,
SET FOR HIGHER PASS.
USES SBLANK BUT AVOIDS ITS TC GETINREL

LEGAL INREL G/ 2

ILLEGAL INREL= 0,1
LEGAL INREL = 2

NEEDED FOR BLANKSUB

ZERO X, Y, Z REG.



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 16 E0 S4

0633	REP	19	LAST	316	40,2444	50 137 1	INDEX	INREL		
0634	REP	2	LAST	313	40,2445	55=004 0	TS	XREGLP	-2	
0635	REP	4	LAST	315	40,2446	54 124 1	TS	CODE		
0636	REP	20	LAST	317	40,2447	50 137 1	INDEX	INREL		ZERO PERTINENT DEC COMP BIT.
0637	REP	27	LAST	314	40,2450	4 4704 1	CS	BIT7		PROTECT OTHERS
0638	REP	8	LAST	315	40,2451	7 1000 1	MASK	DECBRNCH		
0639	REP	1			40,2452	7 2501 0	MASK	BRNCHCON		ZERO LOW 2 BITS.
0640	REP	9	LAST	317	40,2453	55=000 1	TS	DECBRNCH		
0641	REP	21	LAST	317	40,2454	50 137 1	INDEX	INREL		
0642	REP	1			40,2455	3 2471 1	CAP	SINBLANK	-2	BLANK ISOLATED CHAR SEPARATELY
0643	REP	2	LAST	311	40,2456	54 143 0	TS	COUNT		
0644	REP	2	LAST	311	40,2457	0 3225 1	TC	DSPIN		
0645	REP	22	LAST	317	40,2460	50 137 1	INDEX	INREL		
0646	REP	2	LAST	316	40,2461	3 2474 1	CAP	DOUBLK	-2	
0647	REP	15	LAST	316	40,2462	54 777 1	TS	DSPCOUNT		
0648	REP	2	LAST	314	40,2463	0 2502 1	TC	2BLANK		
0649	REP	6	LAST	314	40,2464	4 4711 0	CS	TWO		
0650	REP	16	LAST	317	40,2465	26 777 1	ADS	DSPCOUNT		
0651	REP	3	LAST	317	40,2466	0 2502 1	TC	2BLANK		
0652	REP	23	LAST	317	40,2467	50 137 1	INDEX	INREL		
0653	REP	3	LAST	315	40,2470	3 4331 1	CAP	R1DY	-2	
0654	REP	17	LAST	317	40,2471	54 777 1	TS	DSPCOUNT		SET DSPCOUNT TO LEFT MOST DSP NUMBER
0655	REP	27	LAST	315	40,2472	0 0001 0	TC	L		OF REG. JUST BLANKED
0656					40,2473	00016 0	SINBLANK	OCT	16	DEC 14
0657					40,2474	00005 1		OCT	5	
0658					40,2475	00004 0		OCT	4	
0659					40,2476	00015 0	DOUBLK	OCT	15	DEC 13
0660					40,2477	00011 1		OCT	11	DEC 9
0661					40,2500	00003 1		OCT	3	
0662					40,2501	77774 0	BRNCHCON	OCT	77774	
R0663	2BLANK BLANKS TWO CHAR. PLACE DSP NUMBER OF LEFT CHAR OF THE PAIR INTO									
R0664	DSPCOUNT. THIS NUMBER IS LEFT IN DSPCOUNT									
0665	REP	16	LAST	317	40,2502	3 0777 0	2BLANK	CA	DSPCOUNT	
0666	REP	4	LAST	261	40,2503	54 021 0	TS	SR		
0667	REP	1			40,2504	4 2515 0	CS	BLANKCON		
0668					40,2505	0 0004 0	INHINT			
0669	REP	5	LAST	317	40,2506	50 021 1	INDEX	SR		
0670	REP	25	LAST	167	40,2507	57=023 1	XCH	DSPTAB		
0671					40,2510	0 0006 1	EXTEND			
0672					40,2511	6 2513 1	BZMP	+2		IF OLD CONTENTS -, NOUT OK
0673	REP	6	LAST	168	40,2512	25=016 1	INCR	NOUT		IF OLD CONTENTS +, +1 TO NOUT
0674					40,2513	0 0003 1	RELINT			IF -,NOUT OK
0675	REP	47	LAST	316	40,2514	0 0002 0	TC	0		
0676					40,2515	04000 0	BLANKCON	OCT	4000	

L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 17 E0 S4

P0877 ENTER PASS 0 IS THE EXECUTE FUNCTION. HIGHER ORDER ENTERS ARE TO LOAD
 R0878 DATA. THE SIGN OF REQRET DETERMINES THE PASS, + FOR PASS 0, - FOR HIGHER
 R0879 PASSES.
 R0880 MACHINE CADR TO BE SPECIFIED (NOTBS) NOUNS DESIRE AN ECADR TO BE LOADED
 R0881 WHEN USED WITH LOAD VERBS, MONITOR VERBS, OR DISPLAY VERBS (EXCEPT
 R0882 VERB = FIXED MEMORY DISPLAY, WHICH REQUIRES AN FCADR).

0883 41,2000 BANK 41
 088301 REF 1 41,2000 SETLOC PINBALL2
 088302 41,2000 BANK

06835 REF 1 COUNT 41/PIN

0884 REF 1 41,2000 0 3534 0 NVSUBB TC NVSUB1
 0885 REF 1 41,2001 0 2771 1 LOADLV1 TC LOADLV
 A0886
 06887 REF 40 LAST 318 41,2002 3 4714 1 ENTER CAP ZERO
 06888 REF 8 LAST 316 41,2003 55*015 0 TS CLPASS
 0889 REF 2 LAST 314 41,2004 3 4233 1 CAP ENDINST
 0890 REF 2 LAST 314 41,2005 54 136 1 TS ENTRET
 0891 REF 4 LAST 316 41,2008 11*013 0 CCS REQRET
 0892 REF 1 41,2007 0 2035 0 TC ENTPAS0
 0893 REF 2 LAST 316 41,2010 0 2035 0 TC ENTPAS0
 0894 41,2011 0 2012 0 TC +1
 0895 REF 1 41,2012 3 2033 0 ENTPASHI CAP MMADREF
 0896 REF 5 LAST 318 41,2013 6 1013 1 AD REQRET
 0697 41,2014 0 0008 1 EXTEND
 0898 REF 1 41,2015 1 2027 1 BZF ACCEPTED
 0899 REF 7 LAST 315 41,2018 3 6214 0 CAP THREE
 0700 REF 10 LAST 317 41,2017 7 1000 1 MASK DECORCH
 0701 REF 85 LAST 316 41,2020 10 000 0 CCS A
 0702 41,2021 0 2023 1 TC +2
 0703 REF 2 LAST 318 41,2022 0 2027 0 TC ACCEPTED
 0704 REF 19 LAST 317 41,2023 10 777 1 CCS DSPCOUNT
 0705 REF 1 41,2024 0 2350 0 TC GODSPALM
 0708 REF 2 LAST 318 41,2025 0 2350 0 TC GODSPALM
 0707 41,2028 0 2027 0 TC +1
 0708 REF 6 LAST 318 41,2027 4 1013 0 ACCEPTED CS REQRET
 0709 REF 7 LAST 316 41,2030 55*013 0 TS REQRET
 0710 REF 2 LAST 238 41,2031 0 4447 1 TC FLASHOFF
 0711 REF 8 LAST 318 41,2032 0 1013 1 TC REQRET

0712 REF 3 LAST 318 0136 ENTEXIT = ENTRET

0713 REF 1 41,2033 03421 0 MMADREF ADRES MMCHANG +1

STANDARD LEAD INS. DONT MOVE.

END OF STANDARD LEAD INS.

IF +, PASS 0
 IF +, PASS 0
 IF -, NOT PASS 0

IF L/ 2 CHAR IN FOR MM CODE, ALARM
 AND RECYCLE(DECIDE AT MMCHANG+1).

IF DEC, ALARM IF L/ 5 CHAR IN FOR DATA,
 BUT LEAVE REQRET - AND FLASH ON, SO
 OPERATOR CAN SUPPLY MISSING NUMERICAL
 CHARACTERS AND CONTINUE.
 OCTAL. ANY NUMBER OF CHAR OK.

LESS THAN 5 CHAR DEC(DSPCOUNT IS +)
 LESS THAN 5 CHAR DEC(DSPCOUNT IS +)
 5 CHAR IN (DSPCOUNT IS -)
 5 CHAR IN (DSPCOUNT IS -)
 SET REQRET +.

ASSUMES TC REQRET AT MMCHANG.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 18

E0 S4

0714				41,2034	00034 0	LOWVERB	DEC	28	
0715	REF	41	LAST	318	41,2035	3 4714 1	ENTPAS0	CAP	ZERO
0716	REF	11	LAST	318	41,2036	55=000 1		TS	DECBRNCH
0717	REF	3	LAST	314	41,2037	4 4374 1		CS	VD1
0718	REF	20	LAST	318	41,2040	54 777 1		TS	DSPCOUNT
0719	REF	9	LAST	318	41,2041	4 1001 0	TESTVB	CS	VERBREG
0720	REF	1			41,2042	55=041 1		TS	VERBSAVE
0721	REF	1			41,2043	6 2034 1		AD	LOWVERB
0722					41,2044	0 0006 1		EXTEND	
0723	REF	1			41,2045	6 2133 1		BZMF	VERBPAN
0724					41,2046	0 0006 1	TESTNN	EXTEND	
0725	REF	1			41,2047	3 2114 1		DCA	LODNNLOC
0726	REF	3	LAST	266	41,2050	52 006 0		DXCH	Z
0727	REF	3	LAST	265	41,2051	50 140 1		INDEX	MIXBR
0728					41,2052	0 2052 1		TC	+0
0729					41,2053	0 2055 0		TC	+2
0730	REF	1			41,2054	0 2221 1		TC	MIXNOUN
0731	REF	3	LAST	265	41,2055	10 146 0		CCS	NNADTEM
0732	REF	2	LAST	319	41,2056	0 2131 0		TC	VERBPAN -2
0733	REF	3	LAST	318	41,2057	0 2350 0		TC	GODSPALM
0734	REF	1			41,2060	0 2064 1		TC	REQADD
0735	REF	1			41,2061	25=017 0		INCR	NOUNCADR
0736	REF	1			41,2062	0 4325 1		TC	SETNADD
0737	REF	1			41,2063	0 2120 0		TC	INTMCBTS +2
0738	REF	21	LAST	185	41,2064	3 4674 0	REQADD	CAP	BIT15
0739	REF	9	LAST	318	41,2065	55=015 0		TS	CLPASS
0740	REF	3	LAST	318	41,2066	4 4233 0		CS	ENDINST
0741	REF	1			41,2067	6 0136 0		AD	ENTEXIT
0742					41,2070	0 0006 1		EXTEND	
0743					41,2071	1 2073 0		BZP	+2
0744	REF	2	LAST	319	41,2072	0 2116 0		TC	INTMCBTS
0745	REF	1			41,2073	0 2306 0		TC	REQDATZ
0746	REF	12	LAST	319	41,2074	11=000 1		CCS	DECBRNCH
0747	REF	1			41,2075	0 4161 0		TC	ALMCYCLE
0748	REF	4	LAST	319	41,2076	4 4374 1		CS	VD1
0749	REF	21	LAST	319	41,2077	54 777 1		TS	DSPCOUNT
0750	REF	3	LAST	310	41,2100	11=042 1		CCS	CADRSTOR
0751					41,2101	0 2104 0		TC	+3
0752	REF	1			41,2102	0 2105 1		TC	USEADD
0753					41,2103	0 2104 0		TC	+1
0754	REF	1			41,2104	0 4443 0		TC	FLASHON
0755	REF	1			41,2105	57=005 0	USEADD	XCH	ZREG
0756	REF	1			41,2106	0 4317 0		TC	SETNCADR
0757					41,2107	0 0006 1		EXTEND	
0758	REF	2	LAST	319	41,2110	3 2114 1		DCA	LODNNLOC
0759	REF	4	LAST	319	41,2111	52 006 0		DXCH	Z
0760	REF	3	LAST	319	41,2112	0 2133 1		TC	VERBPAN
0761	REF	22	LAST	319	0777			BRANK=	DSPCOUNT

LOWER VERB THAT AVOIDS NOUN TEST.

NOUN VERB SUB ENTERS HERE

BLOCK FURTHER NUM CHAR, SO THAT STRAY
CHAR DO NOT GET INTO VERB OR NOUN LTS.
IF VERB IS G/E LOWVB, SKIP NOUN TEST.
SAVE VERB FOR POSSIBLE RECYCLE.
LOWVERB - VB

VERB G/E LOWVERB
VERB L/ LOWVERB
SWITCH BANKS TO NOUN TABLE READING
ROUTINE.

NORMAL
MIXED
NORMAL

NORMAL IF +
NOT IN USE IF +0
SPECIFY MACHINE CADR IF -
AUGMENT MACHINE CADR IF -0
ECADR FROM NOUNCADR. SETS EB, NOUNADD.

SET CLPASS FOR PASS0 ONLY

TEST IF REACHED HERE FROM INTERNAL OR
FROM EXTERNAL

EXTERNAL MACH CADR TO BE SPECIFIED

EXTERNAL MACH CADR TO BE SPECIFIED
ALARM AND RECYCLE IF DECIMAL USED
FOR MCBTS.
OCTAL USED OK
BLOCK NUM CHAR IN

EXTERNAL MCBTS DISPLAY WILL LEAVE FLASH
ON IF ENDIDLE NOT = +0.

ECADR INTO NOUNCADR. SET EB, NOUNADD.

SWITCH BANKS TO NOUN TABLE READING
ROUTINE.



L PINBALL GAME BUTTONS AND LIGHTS

USER=5 PAGE NO. 19 E# 54

0762	REF	1		41,2113	02062 1	LODNNLOC	2CADR	LODNNTAB	
0762	REF	1		41,2114	64101 0				
0763				41,2115	77772 0	NEG5	OCT	77772	
0764	REF	70	LAST	313	41,2116	3 0156 0	INTMCB5	CA	MPAC +2
0765	REF	2	LAST	319	41,2117	0 4317 0	TC	SETNCADR	
0768	REF	5	LAST	227	41,2120	4 4715 1	CS	FIVE	
0767	REF	10	LAST	319	41,2121	6 1001 1	AD	VERBREG	
0768					41,2122	0 0006 1	EXTEND		
0769	REF	4	LAST	319	41,2123	1 2133 0	BZF	VERBFAN	
0770	REF	2	LAST	315	41,2124	3 4335 0	CAP	R3D1	
0771	REF	23	LAST	319	41,2125	54 777 1	TS	DSPCOUNT	
0772	REF	2	LAST	319	41,2126	3 1017 0	CA	NOUNCADR	
0773	REF	1			41,2127	0 3353 1	TC	DSPCOTWD	
0774	REF	5	LAST	320	41,2130	0 2133 1	TC	VERBFAN	
0775	REF	22	LAST	318	41,2131	6 4712 1	AD	ONE	
0776	REF	3	LAST	320	41,2132	0 4317 0	TC	SETNCADR	
0777	REF	1			41,2133	4 2145 1	VERBFAN	CS	LST2CON
0778	REF	11	LAST	320	41,2134	6 1001 1	AD	VERBREG	
0779	REF	86	LAST	318	41,2135	10 000 0	CCS	A	
0780	REF	23	LAST	320	41,2136	6 4712 1	AD	ONE	
0781					41,2137	0 2141 1	TC	+2	
0782	REF	1			41,2140	0 2146 0	TC	VBFANDIR	
0783	REF	71	LAST	320	41,2141	54 154 0	TS	MPAC	
0784	REF	4	LAST	196	41,2142	0 4473 0	TC	RELDSP	
0785	REF	16	LAST	311	41,2143	0 4574 0	TC	POSTJUMP	
0786	REF	1			41,2144	66000 1	CADR	GOEXTVB	
0788					41,2145	00050 1	LST2CON	DEC	40
0790	REF	12	LAST	320	41,2146	51*001 1	VBFANDIR	INDEX	VERBREG
0791	REF	1			41,2147	3 2151 0	CAP	VERBTAB	
0792	REF	1			41,2150	0 4577 0	TC	BANKJUMP	
0793	REF	4	LAST	319	41,2151	62350 0	VERBTAB	CADR	GODSPALM
0794	REF	1			41,2152	62364 1	CADR	DSPA	
0795	REF	1			41,2153	62372 0	CADR	DSPB	
0796	REF	1			41,2154	62377 0	CADR	DSPC	
0797	REF	1			41,2155	62357 1	CADR	DSPAB	
0798	REF	1			41,2156	62352 1	CADR	DSPABC	
0799	REF	1			41,2157	62520 1	CADR	DECDSP	
0800	REF	1			41,2160	60675 0	CADR	DSPDPDEC	
0801	REF	5	LAST	320	41,2161	62350 0	CADR	GODSPALM	
0802	REF	6	LAST	320	41,2162	62350 0	CADR	GODSPALM	
0803	REF	1			41,2163	61323 1	CADR	DSPALARM	
0804	REF	1			41,2164	63220 1	CADR	MONITOR	
0805	REF	2	LAST	320	41,2165	63220 1	CADR	MONITOR	
0806	REF	3	LAST	320	41,2166	63220 1	CADR	MONITOR	
0807	REF	4	LAST	320	41,2167	63220 1	CADR	MONITOR	

INTERNAL MACH CADR TO BE SPECIFIED.
ECADR INTO NOUNCADR. SET EB, NOUNADD.
NVSUB CALL LEFT CADR IN MPAC+2 FOR MACH
CADR TO BE SPECIFIED.

DONT DISPLAY CADR IF VB = 05.
VB NOT = 05. DISPLAY CADR.

ECADR INTO NOUNCADR. SETS EB, NOUNADD.

VERB-LST2CON

VERB G/ LST2CON

VERB L/ LST2CON

RELEASE DISPLAY SYST
GO TO GOEXTVB WITH VB-40 IN MPAC.

FIRST LIST2 VERB (EXTENDED VERB)

VB00 ILLEGAL
VB01 DISPLAY OCT COMP 1 (R1)
VB02 DISPLAY OCT COMP 2 (R1)
VB03 DISPLAY OCT COMP 3 (R1)
VB04 DISPLAY OCT COMP 1,2 (R1,R2)
VB05 DISPLAY OCT COMP 1,2,3 (R1,R2,R3)
VB06 DECIMAL DISPLAY
VB07 DP DECIMAL DISPLAY (R1,R2)
VB08 SPARE
VB09 SPARE
VB10 SPARE
VB11 MONITOR OCT COMP 1 (R1)
VB12 MONITOR OCT COMP 2 (R1)
VB13 MONITOR OCT COMP 3 (R1)
VB14 MONITOR OCT COMP 1,2 (R1,R2)



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 20

EO S4

0808	REF	5	LAST	320	41,2170	63220	1	CADR	MONITOR	VB15	MONITOR OCT COMP 1,2,3 (R1,R2,R3)	
0809	REF	6	LAST	321	41,2171	63220	1	CADR	MONITOR	VB16	MONITOR DECIMAL	
0810	REF	7	LAST	321	41,2172	63220	1	CADR	MONITOR	VB17	MONITOR DP DEC (R1,R2)	
0811	REF	7	LAST	320	41,2173	62350	0	CADR	GODSPALM	VB18	SPARE	
0812	REF	8	LAST	321	41,2174	62350	0	CADR	GODSPALM	VB19	SPARE	
0813	REF	9	LAST	321	41,2175	62350	0	CADR	GODSPALM	VB20	SPARE	
0814	REF	1			41,2176	62726	0	CADR	ALOAD	VB21	LOAD COMP 1 (R1)	
0815	REF	1			41,2177	62737	0	CADR	BLOAD	VB22	LOAD COMP 2 (R2)	
0816	REF	1			41,2200	62754	0	CADR	CLOAD	VB23	LOAD COMP 3 (R3)	
0817	REF	1			41,2201	62877	0	CADR	APLOAD	VB24	LOAD COMP 1,2 (R1,R2)	
0818	REF	1			41,2202	62812	0	CADR	ABLOAD	VB25	LOAD COMP 1,2,3 (R1,R2,R3)	
0819	REF	10	LAST	321	41,2203	62350	0	CADR	GODSPALM	VB26	SPARE	
0820	REF	1			41,2204	63343	0	CADR	DSPFMEN	VB27	FIXED MEMORY DISPLAY	
A0821											THE FOLLOWING VERBS MAKE NO NOUN TEST	
0822	REF	11	LAST	321	41,2205	62350	0	CADR	GODSPALM	VB28	SPARE	
0823	REF	12	LAST	321	41,2208	62350	0	CADR	GODSPALM	VB29	SPARE	
0824	REF	1			41,2207	63456	0	REQEXLOC	CADR	VBROEXEC	VB30	REQUEST EXECUTIVE
0825	REF	1			41,2210	63502	0	CADR	VBROWAIT	VB31	REQUEST WAITLIST	
0826	REF	1			41,2211	61360	0	CADR	VBRESEQ	VB32	RESEQUENCE	
0827	REF	1			41,2212	61343	1	CADR	VBPROC	VB33	PROCEED WITHOUT DATA	
0828	REF	1			41,2213	61351	1	CADR	VBTERM	VB34	TERMINATE CURRENT TEST OR LOAD REQ	
0829	REF	1			41,2214	63803	1	CADR	VBSTILTS	VB35	TEST LIGHTS	
0830	REF	1			41,2215	12347	1	CADR	SLAP1	VB36	FRESH START	
0831	REF	2	LAST	318	41,2216	63420	1	CADR	MMCHANG	VB37	CHANGE MAJOR MODE	
0832	REF	13	LAST	321	41,2217	62350	0	CADR	GODSPALM	VB38	SPARE	
0833	REF	14	LAST	321	41,2220	62350	0	CADR	GODSPALM	VB39	SPARE	
R0834											THE LIST2 VERBFAN IS LOCATED IN THE EXTENDED VERB BANK.	



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 21 E0 S4

P0835 NNADTAB CONTAINS A RELATIVE ADDRESS, IDADDREL (IN LOT 10 BITS), REFERRING
R0836 TO WHERE 3 CONSECUTIVE ADDRESSES ARE STORED (IN IDADDTAB).
R0837 MIXNOUN GETS DATA AND STORES IN MIXTEMP,+1,+2. IT SETS NOUNADD FOR
R0838 MIXTEMP.

0839	REF	4	LAST	319	41,2221	10 146 0	MIXNOUN	CCS	NNADTEM	
0840					41,2222	0 2228 0		TC	+4	
0841	REF	15	LAST	321	41,2223	0 2350 0		TC	GODSPALM	
0842					41,2224	0 2228 0		TC	+2	
0843					41,2225	0 2228 0		TC	+1	
0844	REF	11	LAST	222	41,2228	4 8211 1		CS	SIX	
0845	REF	13	LAST	320	41,2227	6 1001 1		AD	VERBRE0	
0846					41,2230	0 0008 1		EXTEND		
0847					41,2231	6 2233 1		BZMP	+2	
0848	REF	6	LAST	320	41,2232	0 2133 1		TC	VERBFAN	
0849	REF	9	LAST	317	41,2233	3 4711 1		CAP	TWO	
0850	REF	1			41,2234	54 117 1	MIXNN1	TS	DECOUNT	
0851	REF	1			41,2235	6 2260 1		AD	MIXAD	
0852	REF	1			41,2236	54 145 0		TS	NOUNADD	
0853	REF	2	LAST	322	41,2237	50 117 0		INDEX	DECOUNT	
0854	REF	2	LAST	265	41,2240	3 0150 0		CA	IDAD1TEM	
0855	REF	1			41,2241	54 122 1		TS	NOUNTEM	
A0858										
A0857										
0856	REF	1			41,2242	0 3027 1		TC	SPRUTMIX	
0859	REF	1			41,2243	0 2281 0		TC	DPTTEST	
0860	REF	1			41,2244	0 2248 0		TC	MIXNN2	
0861	REF	2	LAST	322	41,2245	24 122 0		INCR	NOUNTEM	
0862	REF	3	LAST	322	41,2248	3 0122 0	MIXNN2	CA	NOUNTEM	
0863	REF	3	LAST	131	41,2247	7 4372 1		MASK	LOW11	
0864	REF	1			41,2250	0 4327 0		TC	SETERBANK	
0865	REF	67	LAST	320	41,2251	50 000 1		INDEX	A	
0866					41,2252	3 0000 1		CA	0	
0867	REF	2	LAST	322	41,2253	50 145 1		INDEX	NOUNADD	
0868					41,2254	56 000 1		XCH	0	
0869	REF	3	LAST	322	41,2255	10 117 1		CCS	DECOUNT	
0870	REF	1			41,2256	0 2234 0		TC	MIXNN1	
0871	REF	7	LAST	322	41,2257	0 2133 1		TC	VERBFAN	
0872	REF	3	LAST	316	41,2260	0 0125 1	MIXAD	TC	MIXTEMP	
R0873	DPTTEST									
R0874										
R0875										
0878	REF	88	LAST	322	41,2261	50 000 1	DPTTEST	INDEX	A	
0877					41,2262	1 2283 0		TCF	+1	
0878	REF	48	LAST	317	41,2263	0 0002 0		TC	0	
0879	REF	49	LAST	322	41,2264	0 0002 0		TC	0	

+ IN USE
+0 NOT IN USE
- IN USE
-0 IN USE

VERB L/E 6
AVOID MIXNOUN SWAP IF VB NOT = DISPLAY

SET NOUNADD TO MIXTEMP + K
GET IDADDTAB ENTRY FOR COMPONENT K
OF NOUN.

TEST FOR DP (FOR OCT DISPLAY). IF SO, GET
MINOR PART ONLY.
GET SF ROUT NUMBER IN A

NO DP
DP GET MINOR PART

ESUBK (NO DP) OR (ESUBK)+1 FOR DP
SET EBANK, LEAVE EADRES IN A.
PICK UP C(ESUBK) NOT DP
OR C((ESUBK)+1) FOR DP MINOR PART

STORE IN MIXTEM + K

OCTAL ONLY NO DP
FRACT NO DP



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 22

E0 S4

0880	REF	50	LAST	322	41,2285	0 0002 0	TC	Q
0881	REF	51	LAST	323	41,2286	0 0002 0	TC	Q
0882	REF	1			41,2287	1 2300 1	TCP	DPTEST1
0883	REF	2	LAST	323	41,2270	1 2300 1	TCP	DPTEST1
0884	REF	52	LAST	323	41,2271	0 0002 0	TC	Q
0885	REF	3	LAST	323	41,2272	1 2300 1	TCP	DPTEST1
0886	REF	53	LAST	323	41,2273	0 0002 0	TC	Q
0887	REF	54	LAST	323	41,2274	0 0002 0	TC	Q
0888	REF	4	LAST	323	41,2275	1 2300 1	TCP	DPTEST1
08881	REF	55	LAST	323	41,2276	0 0002 0	TC	Q
08882	REF	56	LAST	323	41,2277	0 0002 0	TC	Q
0889	REF	57	LAST	323	41,2300	50 002 0	DPTEST1	INDEX
0890					41,2301	0 0001 0	TC	1
0891	REF	4	LAST	317	41,2302	3 4333 0	REQDATX	CAP R1D1
0892	REF	1			41,2303	1 2307 0	TCP	REQCOM
0893	REF	2	LAST	315	41,2304	3 4334 1	REQDATY	CAP R2D1
0894	REF	2	LAST	323	41,2305	1 2307 0	TCP	REQCOM
0895	REF	3	LAST	320	41,2306	3 4335 0	REQDATZ	CAP R3D1
0896	REF	24	LAST	320	41,2307	54 777 1	REQCOM	TS DSPCOUNT
0897	REF	58	LAST	323	41,2310	4 0002 1	CS	Q
0898	REF	9	LAST	316	41,2311	55=013 0	TS	REQRET
0899	REF	39	LAST	316	41,2312	0 4555 0	TC	BANKCALL
0900	REF	2	LAST	316	41,2313	60437 1	CADR	5BLANK
0901	REF	2	LAST	319	41,2314	0 4443 0	TC	FLASHON
0902	REF	2	LAST	319	41,2315	0 0136 0	ENDRODAT	TC ENTEXIT
0903	REF	8	LAST	314	41,2316	55=002 0	TS	NOUNREG
0904	REF	59	LAST	323	41,2317	58 002 0	UPDATNN	XCH Q
0905	REF	1			41,2320	54 117 1	TS	UPDATRET
0906					41,2321	0 0006 1	EXTEND	
0907	REF	3	LAST	319	41,2322	3 2114 1	DCA	LODNNLOC
0908	REF	5	LAST	319	41,2323	52 008 0	DXCH	Z
0909	REF	5	LAST	322	41,2324	10 146 0	CCS	NNADJEM
0910	REF	24	LAST	320	41,2325	6 4712 1	AD	ONE
0911	REF	1			41,2326	1 2331 0	TCP	PUTADD
0912	REF	2	LAST	323	41,2327	1 2332 0	TCP	PUTADD +1
0913	REF	3	LAST	323	41,2330	1 2332 0	TCP	PUTADD +1
0914	REF	4	LAST	320	41,2331	0 4317 0	PUTADD	TC SETNCADR
0915	REF	2	LAST	314	41,2332	3 4375 1	CAP	ND1
0916	REF	25	LAST	323	41,2333	54 777 1	TS	DSPCOUNT
0917	REF	9	LAST	323	41,2334	3 1002 1	CA	NOUNREG
0918	REF	1			41,2335	1 2344 1	TCP	UPDAT1
0919	REF	14	LAST	322	41,2336	55=001 0	TS	VERBREG
0920	REF	60	LAST	323	41,2337	58 002 0	UPDATVB	XCH Q
0921	REF	2	LAST	323	41,2340	54 117 1	TS	UPDATRET
0922	REF	5	LAST	319	41,2341	3 4374 0	CAP	VD1
0923	REF	26	LAST	323	41,2342	54 777 1	TS	DSPCOUNT

DEG NO DP
ARITH NO DP
DP1OUT
DP2OUT
OPDEG NO DP
DP3OUT
HMS NO DP
M/S NO DP
DP4OUT
ARITH1 NO DP
2INTOUT NO DP TO GET HI PART IN MPAC
RETURN TO L+2

SWITCH BANKS TO NOUN TABLE READING
ROUTINE.

NORMAL

MC1BS DONT CHANGE NOUNADD
MC1BI DONT CHANGE NOUNADD
ECADR INTO NOUNCADR. SETS EB, NOUNADD.



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 26,1966 KOOLADE .069 PAGE 324

L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 23 E0 S4

0924	REF	15	LAST	323	41,2343	3	1001	1	CA	VERBREG
0925	REF	17	LAST	320	41,2344	0	4574	0	UPDAT1	TC
0926	REF	1			41,2345	6	1222	1	CADR	POSTJUMP
0927	REF	3	LAST	323	41,2346	0	0117	0	TC	GOVNUPT
0928	REF	2	LAST	319	41,2347	0	4161	0	TC	UPDATRET
0929	REF	16	LAST	324	41,2350	0	4574	0	GOALMCYC	TC
0930	REF	2	LAST	320	41,2351	6	1323	1	GODSPALM	TC
									CADR	ALMCYCLE
										POSTJUMP
										DSPALARM

CANT USE SWCALL TO GO TO DSPDECVN, SINCE
UPDATVB CAN ITSELF BE CALLED BY SWCALL.

NEEDED BECAUSE BANKJUMP CANT HANDLE P/F.



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 24 E0 S4

R0931 NOUN TABLES

R0932 NOUN CODE L/40, NORMAL NOUN CASE. NOUN CODE G/E 40, MIXED NOUN CASE.
R0933 FOR NORMAL CASE, NNADTAB CONTAINS ONE ECADR FOR EACH NOUN.
R0934 +0 INDICATES NOUN NOT USED. - ENTRY INDICATES MACHINE CADR(E OR P) TO
R0935 BE SPECIFIED. -1 INDICATES CHANNEL TO BE SPECIFIED. -0 INDICATES AUGMENT
R0936 OF LAST MACHINE CADR SUPPLIED.

R0937 FOR MIXED CASE, NNADTAB CONTAINS ONE INDIRECT ADDRESS(IDADDREL) IN LOW
R0938 10 BITS, AND THE COMPONENT CODE NUMBER IN THE HIGH 5 BITS.

R0939 NNTYPDAB IS A PACKED TABLE OF THE FORM M-M-M-M-N-N-N-N-P-P-P-P-P.

R0940 FOR THE NORMAL CASE, M-S ARE THE COMPONENT CODE NUMBER.
R0941 N-S ARE THE SF ROUTINE CODE NUMBER.
R0942 P-S ARE THE SF CONSTANT CODE NUMBER.

R0943 MIXED CASE, M-S ARE THE SF CONSTANT3 CODE NUMBER 3 COMPONENT CASE
R0944 N-S ARE THE SF CONSTANT2 CODE NUMBER
R0945 P-S ARE THE SF CONSTANT1 CODE NUMBER
R0946 N-S ARE THE SF CONSTANT2 CODE NUMBER 2 COMPONENT CASE
R0947 P-S ARE THE SF CONSTANT1 CODE NUMBER
R0948 P-S ARE THE SF CONSTANT1 CODE NUMBER 1 COMPONENT CASE

R0949 THERE IS ALSO AN INDIRECT ADDRESS TABLE(IDADDTAB) FOR MIXED CASE ONLY.
R0950 EACH ENTRY CONTAINS ONE ECADR. IDADDREL IS THE RELATIVE ADDRESS OF
R0951 THE FIRST OF THESE ENTRIES.
R0952 THERE IS ONE ENTRY IN THIS TABLE FOR EACH COMPONENT OF A MIXED NOUN
R0953 THEY ARE LISTED IN ORDER OF ASCENDING K.

R0954 THERE IS ALSO A SCALE FACTOR ROUTINE NUMBER TABLE(RUTMTAB) FOR MIXED
R0955 CASE ONLY. THERE IS ONE ENTRY PER MIXED NOUN. THE FORM IS,
R0956 Q-Q-Q-Q-R-R-R-R-S-S-S-S-S

R0957 Q-S ARE THE SF ROUTINE 3 CODE NUMBER 3 COMPONENT CASE
R0958 R-S ARE THE SF ROUTINE 2 CODE NUMBER
R0959 S-S ARE THE SF ROUTINE 1 CODE NUMBER
R0960 R-S ARE THE SF ROUTINE 2 CODE NUMBER 2 COMPONENT CASE
R0961 S-S ARE THE SF ROUTINE 1 CODE NUMBER

R0962 IN OCTAL DISPLAY AND LOAD (OCT OR DEC) VERBS, EXCLUDE USE OF VERBS WHOSE
R0963 COMPONENT NUMBER IS GREATER THAN THE NUMBER OF COMPONENTS IN NOUN.

R0964 (ALL MACHINE ADDRESS TO BE SPECIFIED NOUNS ARE 3 COMPONENT.)
R0967 IN MULTI-COMPONENT LOAD VERBS, NO MIXING OF OCTAL AND DECIMAL DATA
R0968 COMPONENT WORDS IS ALLOWED. ALARM IF VIOLATION.

R0969 IN DECIMAL LOADS OF DATA, 5 NUMERICAL CHARACTERS MUST BE KEYED IN
R0970 BEFORE EACH ENTER. IF NOT, ALARM.

L PINBALL GAME BUTTONS AND LIGHTS

USRA-S PAGE NO. 25 E0 S4

```

P0971      DISPLAY VERBS
0972  REF 10 LAST 322 41,2352 4 4711 0 DSPABC CS TWO
0973  REF 1      41,2353 0 2423 0 TC COMPTST
0974  REF 3 LAST 322 41,2354 50 145 1 INDEX NOUNADD
0975      41,2355 4 0002 1 CS 2
0976  REF 36 LAST 301 41,2356 58 132 1 XCH BUP +2
0977  REF 25 LAST 323 41,2357 4 4712 0 DSPAB CS ONE
0978  REF 2 LAST 326 41,2360 0 2423 0 TC COMPTST
0979  REF 4 LAST 326 41,2361 50 145 1 INDEX NOUNADD
0980      41,2362 4 0001 1 CS 1
0981  REF 37 LAST 326 41,2363 58 131 1 XCH BUP +1
0982  REF 1      41,2364 0 2442 1 DSPA TC DECTEST
0983  REF 1      41,2385 0 2465 1 TC TSIFODP
0984  REF 5 LAST 326 41,2366 50 145 1 INDEX NOUNADD
0985      41,2387 4 0000 0 CS 0
0986  REF 38 LAST 326 41,2370 58 130 0 DSPCOM1 XCH BUP
0987  REF 1      41,2371 0 2404 0 TC DSPCOM2
0988  REF 26 LAST 326 41,2372 4 4712 0 DSPB CS ONE
0989  REF 1      41,2373 0 2438 1 TC DCOMPTST
0990  REF 6 LAST 326 41,2374 50 145 1 INDEX NOUNADD
0991      41,2375 4 0001 1 CS 1
0992  REF 1      41,2376 0 2370 1 TC DSPCOM1
0993  REF 11 LAST 326 41,2377 4 4711 0 DSPC CS TWO
0994  REF 2 LAST 326 41,2400 0 2438 1 TC DCOMPTST
0995  REF 7 LAST 326 41,2401 50 145 1 INDEX NOUNADD
0996      41,2402 4 0002 1 CS 2
0997  REF 2 LAST 326 41,2403 0 2370 1 TC DSPCOM1
0998  REF 12 LAST 326 41,2404 4 4711 0 DSPCOM2 CS TWO
0999  REF 16 LAST 324 41,2405 6 1001 1 AD VERBREG
1000  REF 89 LAST 322 41,2406 10 000 0 CCS A
1001  REF 1      41,2407 0 2412 1 TC DSPCOM3
1002  REF 3 LAST 323 41,2410 0 0136 0 TC ENTEXIT
1003      41,2411 0 2412 1 TC +1
1004  REF 1      41,2412 54 122 1 DSPCOM3 TS DISTEM
1005  REF 90 LAST 326 41,2413 50 000 1 INDEX A
1006  REF 5 LAST 323 41,2414 3 4333 0 CAP RID1
1007  REF 27 LAST 323 41,2415 54 777 1 TS DSPCOUNT
1008  REF 2 LAST 326 41,2418 50 122 0 INDEX DISTEM
1009  REF 39 LAST 326 41,2417 4 0130 1 CS BUP
1010  REF 2 LAST 320 41,2420 0 3353 1 TC DSPCOTWD
1011  REF 3 LAST 326 41,2421 58 122 0 XCH DISTEM
1012  REF 2 LAST 326 41,2422 0 2408 1 TC DSPCOM2 +2
    
```

A B C AB ABC
-1 -0 +1 +2 +3 IN A
+0 +0 +0 +1 +2 IN A AFTER CCS

+0,+1,+2 INTO DISTEM

```

R1013  COMPTST ALARMS IF COMPONENT NUMBER OF VERB(LOAD OR OCT DISPLAY) IS
R1014  GREATER THAN THE HIGHEST COMPONENT NUMBER OF NOUN.
1016  REF 4 LAST 266 41,2423 54 123 0 COMPTST TS SFTMP1
1017  REF 61 LAST 323 41,2424 22 002 0 LACH 0
1022  REF 1      41,2425 0 2512 0 COMPTST1 TC GETCOMP
1023  REF 1      41,2426 0 4345 1 TC LEFTS
1024  REF 8 LAST 318 41,2427 7 6214 1 MASK THREE
    
```

- VERB COMP

NOUN COMP

L PINBALL GAME BUTTONS AND LIGHTS

USER=5 PAGE NO. 26

E0 S4

1025 REF 5 LAST 328 41,2430 6 0123 1 AD SPTMP1
 1026 REF 91 LAST 328 41,2431 10 000 0 CCS A
 1027 REF 28 LAST 317 41,2432 0 0001 0 TC L
 1028 REF 3 LAST 318 41,2433 0 5840 0 TC CSHOLE
 1029 REF 18 LAST 322 41,2434 0 2350 0 TC GODSPALM
 1030 REF 29 LAST 327 41,2435 0 0001 0 NDCMPTST TC L
 R1031 DCMPTST ALARMS IF DECIMAL ONLY BIT (BIT4 OF COMP CODE NUMBER) = 1.
 R1032 IF NOT, IT PERFORMS REGULAR COMPTST.
 1033 REF 6 LAST 327 41,2438 54 123 0 DCMPTST TS SPTMP1
 1034 REF 62 LAST 328 41,2437 22 002 0 LXCH 0
 1035 REF 2 LAST 328 41,2440 0 2442 1 TC DECTEST
 1036 REF 1 41,2441 0 2425 0 TC COMPTST1

NOUN COMP - VERB COMP
 NOUN COMP G/ VERB COMP
 NOUN COMP L/ VERB COMP
 NOUN COMP = VERB COMP

- VERB COMP

1037 41,2442 0 0006 1 DECTEST EXTEND
 1038 REF 72 LAST 320 41,2443 22 156 0 QXCH MPAC +2
 1039 REF 2 LAST 328 41,2444 0 2512 0 TC GETCOMP
 1040 REF 25 LAST 224 41,2445 7 4875 0 MASK BIT14
 1041 REF 92 LAST 327 41,2446 10 000 0 CCS A
 1042 REF 17 LAST 327 41,2447 0 2350 0 TC GODSPALM
 1043 REF 73 LAST 327 41,2450 0 0156 0 TC MPAC +2
 1044 REF 63 LAST 327 41,2451 22 002 0 DCTSTCYC LXCH 0
 1045 REF 3 LAST 327 41,2452 0 2512 0 TC GETCOMP
 1046 REF 26 LAST 327 41,2453 7 4875 0 MASK BIT14
 1047 REF 93 LAST 327 41,2454 10 000 0 CCS A
 1048 REF 3 LAST 324 41,2455 0 4161 0 TC ALMCYCLE
 1049 REF 30 LAST 327 41,2456 0 0001 0 TC L
 R1050 NOUNTEST ALARMS IF NO-LOAD BIT (BITS OF COMP CODE NUMBER) = 1.
 R1051 IF NOT, IT RETURNS.

ALARMS IF DEC ONLY BIT = 1 (BIT4 OF COMP CODE NUMBER). RETURNS IF NOT.

ALARMS AND RECYCLES IF DEC ONLY BIT = 1 (BIT4 OF COMP CODE NUMBER). RETURNS IF NOT. USED BY LOAD VERBS.

1052 REF 64 LAST 327 41,2457 22 002 0 NOUNTEST LXCH 0
 1053 REF 4 LAST 327 41,2460 0 2512 0 TC GETCOMP
 1054 REF 94 LAST 327 41,2461 10 000 0 CCS A
 1055 REF 31 LAST 327 41,2462 0 0001 0 TC L
 1056 REF 32 LAST 327 41,2463 0 0001 0 TC L
 1057 REF 18 LAST 327 41,2464 0 2350 0 TC GODSPALM
 1058 REF 65 LAST 327 41,2465 22 002 0 TSTFORDP LXCH 0
 1059 REF 6 LAST 323 41,2466 3 0146 1 CA NNADTEM
 1060 REF 27 LAST 328 41,2467 6 4712 1 AD ONE
 1061 41,2470 0 0006 1 EXTEND
 1062 REF 1 41,2471 1 2503 1 BZF CHANDSP
 1063 REF 4 LAST 319 41,2472 50 140 1 INDEX MIXBR
 1064 41,2473 0 2473 0 TC +0
 1065 41,2474 0 2476 0 TC +2

TEST FOR DP. IF SO, GET MINOR PART ONLY.
 IF NNADTEM = -1, CHANNEL TO BE SPECIFIED

NORMAL

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 27 E0 S4

1066	REF	33	LAST	327	41,2475	0 0001 0	TC	L
1067	REF	1			41,2476	0 3021 1	TC	SFRUTINOR
1068	REF	2	LAST	322	41,2477	0 2281 0	TC	DPTTEST
1069	REF	34	LAST	328	41,2500	0 0001 0	TC	L
1070	REF	8	LAST	328	41,2501	24 145 1	INCR	NOUNADD
1071	REF	35	LAST	328	41,2502	0 0001 0	TC	L
1072					41,2503	0 0008 1	CHANDSP	EXTEND
1073	REF	3	LAST	320	41,2504	5 1017 0	INDEX	NOUNCADR
1074					41,2505	00 000 1	READ	0
1075	REF	95	LAST	327	41,2506	4 0000 0	CS	A
1076	REF	3	LAST	328	41,2507	1 2370 0	TCF	DSPCOM1
1077	REF	2	LAST	265	41,2510	00147 0	COMPICK	ADRES NNTYPTM
1078	REF	7	LAST	327	41,2511	00148 1	ADRES	NNADTEM
1079	REF	5	LAST	327	41,2512	50 140 1	GETCOMP	INDEX MIXBR
1080	REF	1			41,2513	3 2507 1	CAP	COMPICK -1
1081	REF	98	LAST	328	41,2514	50 000 1	INDEX	A
1082					41,2515	3 0000 1	CA	0
1083	REF	4	LAST	198	41,2516	7 4384 0	MASK	HI5
1084	REF	68	LAST	327	41,2517	0 0002 0	TC	0
1085	REF	5	LAST	327	41,2520	0 2512 0	DECDSP	TC GETCOMP
1086	REF	2	LAST	328	41,2521	0 4345 1	TC	LEFT5
1087	REF	9	LAST	328	41,2522	7 8214 1	MASK	THREE
1088	REF	4	LAST	322	41,2523	54 117 1	TS	DECOUNT
1089	REF	1			41,2524	54 122 1	DSPDCGET	TS DECTEM
1090	REF	9	LAST	326	41,2525	6 0145 1	AD	NOUNADD
1091	REF	97	LAST	326	41,2526	50 000 1	INDEX	A
1092					41,2527	4 0000 0	CS	0
1093	REF	2	LAST	326	41,2530	50 122 0	INDEX	DECTEM
1094	REF	2	LAST	268	41,2531	57*003 0	XCH	XREG
1095	REF	3	LAST	328	41,2532	10 122 1	CCS	DECTEM
1096	REF	1			41,2533	0 2524 0	TC	DSPDCGET
1097	REF	42	LAST	319	41,2534	3 4714 1	DSPDCPUT	CAP ZERO
1098	REF	74	LAST	327	41,2535	54 155 1	TS	MPAC +1
1099	REF	75	LAST	328	41,2536	54 156 1	TS	MPAC +2
1100	REF	5	LAST	326	41,2537	50 117 0	INDEX	DECOUNT
1101	REF	8	LAST	328	41,2540	3 4333 0	CAP	R1D1
1102	REF	28	LAST	328	41,2541	54 777 1	TS	DSPDCOUNT
1103	REF	8	LAST	328	41,2542	50 117 0	INDEX	DECOUNT
1104	REF	3	LAST	328	41,2543	4 1003 1	CS	XREG
1105	REF	76	LAST	326	41,2544	54 154 0	TS	MPAC
1106	REF	1			41,2545	0 3042 1	TC	SFCNLM
1107	REF	7	LAST	327	41,2546	54 123 0	TS	SFTMP1
1108					41,2547	0 0008 1	EXTEND	

MIXED CASE ALREADY HANDLED IN MIXNOUN

NO DP
DP E+1 INTO NOUNADD FOR MINOR PART.

NORMAL MIXED
ADRES NNTYPTM ADRES NNADTEM
C(NNTYPTM) C(NNADTEM)
GET HI5 OF NNTYPTAB(NORM) OF NNADTAB(MIX)

COMP NUMBER INTO DECOUNT
PICKS UP DATA
DECTEM 1COMP +0, 2COMP +1, 3COMP +2

CANT USE BUF SINCE DMP USE5 IT.

MORE TO GET
DISPLAYS DATA
DECOUNT 1COMP +0, 2COMP +1, 3COMP +2

2X(SF CON NUMB) IN A

SWITCH BANKS TO SF CONSTANT TABLE



L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 28

E0 54

1109 RESP 1 41,2550 3 2562 1 DCA GTSPOUTL
1110 RESP 6 LAST 323 41,2551 52 006 0 DXCH Z
1111 RESP 6 LAST 328 41,2552 50 140 1 INDEX MIXER
1112 41,2553 0 2553 0 TC +0
1113 RESP 1 41,2554 0 2557 1 TC DSPSPNOR
1114 RESP 2 LAST 322 41,2555 0 3027 1 TC SFRUTMIX
1115 RESP 1 41,2556 0 2572 0 TC DECDSP3

READING ROUTINE.
LOADS SPTIMEP1, SPTIMEP2.

1116 RESP 2 LAST 328 41,2557 0 3021 1 DSPSPNOR TC SFRUTNOR
1117 RESP 2 LAST 329 41,2560 0 2572 0 TC DECDSP3

1118 RESP 29 LAST 328 0777 EBANK= DSPCOUNT
1119 RESP 1 41,2561 02120 0 GTSPOUTL 2CADR GTSPOUT
1119 RESP 1 41,2562 64101 0
1120 RESP 40 LAST 323 41,2563 0 4555 0 DSPDCEND TC BANKCALL
1121 RESP 1 41,2564 61131 0 CADR DSPDCEND
1122 RESP 7 LAST 328 41,2565 10 117 1 CCS DECOUNT
1123 41,2566 0 2570 1 TC +2
1124 RESP 4 LAST 326 41,2567 0 0136 0 TC ENTEXIT
1125 RESP 8 LAST 329 41,2570 54 117 1 TS DECOUNT
1126 RESP 1 41,2571 0 2534 1 TC DSPDCPUT
1127 RESP 98 LAST 328 41,2572 50 000 1 DECDSP3 INDEX A
1128 RESP 1 41,2573 3 2575 1 CAP SPQUTABR
1129 RESP 2 LAST 320 41,2574 0 4577 0 TC BANKJUMP

ALL SPOUT ROUTINES END HERE

MORE TO DISPLAY

1130 RESP 1 41,2575 61321 0 SPQUTABR CADR PREDSPAL
1131 RESP 1 41,2576 62563 0 CADR DSPDCEND
1132 RESP 1 41,2577 60516 0 CADR DEGOUTSP
1133 RESP 1 41,2600 60603 1 CADR ARTOUTSP
1134 RESP 1 41,2601 60614 1 CADR DP1OUTSP
1135 RESP 1 41,2602 60621 1 CADR DP2OUTSP
1136 RESP 1 41,2603 60524 1 CADR OFDEGOUT
1137 RESP 1 41,2604 60623 0 CADR DP3OUTSP
1138 RESP 1 41,2605 65143 1 CADR HMSOUT
1139 RESP 1 41,2606 65216 1 CADR M/SOUT
1140 RESP 2 LAST 329 41,2607 60621 1 CADR DP2OUTSP
11401 RESP 1 41,2610 60610 0 CADR ARQUT1SP
11402 RESP 1 41,2611 60636 1 CADR 2INTOUT
1141 41,2612 ENDRTOUT EQUALS

ALARM IF DEC DISP WITH OCTAL ONLY NOUN

R1142 THE FOLLOWING IS ATYPICAL SP ROUTINE . IT USES MPAC. LEAVES RESU
R1143 LTS IN MPAC, MPAC+1. ENDS WITH TC DSPDCEND
1144 RESP 2 LAST 317 40,2516 SETLOC BLANKCON +1

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 29 E0 84

11445 REP 2 LAST 310 TO 318' 334 334* COUNT 40/PIN

R1145 DEGOUTSP SCALES BY .18 THE LOW 14 BITS OF ANGLE , ADDING .18 FOR
R1146 NUMBERS IN THE NEGATIVE (AGC) RANGE.

1147	REP	43	LAST	328	40,2516	3 4714 1	DEGOUTSP	CAP	ZERO	
1148	REP	77	LAST	328	40,2517	54 156 1		TS	MPAC	+2
1149	REP	1			40,2520	0 2555 0		TC	FIXRANGE	
1150					40,2521	0 2523 1		TC	+2	
1151	REP	1			40,2522	0 2550 0		TC	SETAUG	
1152	REP	1			40,2523	0 2588 0		TC	DEGCOM	

SET INDEX FOR FULL SCALE
NO AUGMENT NEEDED (SPTMP1 AND 2 ARE 0)
SET AUGMENTER ACCORDING TO C(MPAC +2)

R1153 OPDEGOUT SCALES BY .45 (THE RANGE IS 90 DEGREES) AND ADDS A 20 DEG BIAS.

1154	REP	78	LAST	330	40,2524	10 154 0	OPDEGOUT	CCS	MPAC	
1155	REP	79	LAST	330	40,2525	58 154 1		XCH	MPAC	
1156					40,2526	0 2531 1		TC	+3	
1157	REP	1			40,2527	0 2540 1		TC	NEGOUT	
1158	REP	4	LAST	298	40,2530	8 7718 0		AD	NEG1	
1159	REP	1			40,2531	8 2802 1		AD	20BIAS	
1160	REP	80	LAST	330	40,2532	54 154 0	BIASCOM	TS	MPAC	
1161					40,2533	0 2538 0		TC	+3	
1162	REP	22	LAST	319	40,2534	3 4874 0		CAP	BIT15	
1163	REP	81	LAST	330	40,2535	28 154 0		ADS	MPAC	
1164	REP	13	LAST	326	40,2538	3 4711 1		CAP	TWO	
1165	REP	2	LAST	329	40,2537	0 2517 0		TC	DEGOUTSP	+1

RANGE IS 90 DEG
IF POS OR POS 0 THEN ADD BIAS AND
CORRECT FOR POSSIBLE OVERFLOW
IF NEG NON ZERO
IF NEG ZERO SUBTRACT 1
TEST FOR OVERFLOW
NO OVFLOW
IF OVFLOW
SET MULTIPLIER TO .45

1166	REP	82	LAST	330	40,2540	56 154 1	NEGOUT	XCH	MPAC	
1167	REP	2	LAST	330	40,2541	6 2602 1		AD	20BIAS	
1168	REP	99	LAST	329	40,2542	10 000 0		CCS	A	
1169	REP	1			40,2543	0 2532 1		TC	BIASCOM	
1170	REP	4	LAST	327	40,2544	0 5840 0		TC	CCSHOLE	
1171	REP	28	LAST	327	40,2545	6 4712 1		AD	ONE	
1172					40,2546	4 0000 0		COM		
1173	REP	2	LAST	330	40,2547	0 2532 1		TC	BIASCOM	

NEGATIVE CASE
IF POS THEN SUBTRACT 1 BECAUSE OF 2SCOM
IF NEG RESTORE SUM
IF NEG 0 LEAVE NEG 0

1174					40,2550	0 0008 1	SETAUG	EXTEND		
1175	REP	83	LAST	330	40,2551	5 0156 0		INDEX	MPAC	+2
1176	REP	1			40,2552	3 2577 0		DCA	DEGTAB	
1177	REP	8	LAST	328	40,2553	52 124 1		DXCH	SPTMP1	
1178	REP	67	LAST	328	40,2554	0 0002 0		TC	Q	

LOADS SPTMP1 AND SPTMP2 WITH THE
DP AUGMENTER CONSTANT

1179	REP	84	LAST	330	40,2555	10 154 0	FIXRANGE	CCS	MPAC	
1180	REP	88	LAST	330	40,2556	0 0002 0		TC	Q	
1181	REP	69	LAST	330	40,2557	0 0002 0		TC	Q	
1182					40,2560	1 2561 0		TCF	+1	
1183	REP	23	LAST	330	40,2561	4 4674 1		CS	BIT15	
1184	REP	85	LAST	330	40,2562	7 0154 0		MASK	MPAC	
1185	REP	86	LAST	330	40,2563	54 154 0		TS	MPAC	
1186	REP	70	LAST	330	40,2564	50 002 0		INDEX	Q	

IF MPAC IS + RETURN TO L+1
IF MPAC IS - RETURN TO L+2 AFTER
MASKING OUT THE SIGN BIT



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 30 E0 S4

1187				40,2565	0 0001 0	TC	1	
1188				40,2566	0 0006 1	DECCOM	EXTEND	
1189	REF	87	LAST	330	40,2567	5 0156 0	INDEX	MPAC +2
1190	REF	2	LAST	330	40,2570	3 2577 0	DCA	DEGTAB
1191	REF	88	LAST	331	40,2571	52 155 1	DXCH	MPAC
1192	REF	4	LAST	312	40,2572	0 7256 1	TC	SHORTMP
1193	REF	9	LAST	330	40,2573	52 124 1	DXCH	SFTMP1
1194	REF	89	LAST	331	40,2574	20 155 1	DAS	MPAC
1195	REF	1			40,2575	0 2606 0	TC	SCOUTEND
1196					40,2576	05605 1	DEGTAB	OCT 05605
1197					40,2577	03656 1	OCT	03656
1198					40,2600	16314 0	OCT	16314
1199					40,2601	31463 1	OCT	31463
								LOADS MULTIPLIER, DOES SHORTMP, AND ADDS AUGMENTER.
								ADJUSTED ANGLE IN A
								HI PART OF .16
								LOW PART OF .16
								HI PART OF .45
								LO PART OF .45
1200					40,2602	16040 1	20BIAS	OCT 16040
								20 DEG BIAS FOR OPTICS
1201	REF	10	LAST	331	40,2603	52 124 1	ARTOUTSF	DXCH SFTMP1
1202	REF	90	LAST	331	40,2604	52 155 1	DXCH	MPAC
1203	REF	1			40,2605	0 4431 0	TC	PRSHRIMP
1204	REF	19	LAST	324	40,2606	0 4574 0	SCOUTEND	TC POSTJUMP
1205	REF	2	LAST	329	40,2607	62563 0	CADR	DSPDCEND
								IF C(A) = -0, SHORIMP FAILS TO GIVE -0.
12051	REF	11	LAST	331	40,2610	52 124 1	AROUT1SF	DXCH SFTMP1
12052	REF	91	LAST	331	40,2611	52 155 1	DXCH	MPAC
12053	REF	2	LAST	331	40,2612	0 4431 0	TC	PRSHRIMP
12054	REF	1			40,2613	0 2615 1	TC	L14/OUT
1206	REF	1			40,2614	0 2627 0	DP1OUTSF	TC DPOUT
1207	REF	92	LAST	331	40,2615	56 156 0	L14/OUT	XCH MPAC +2
1208	REF	93	LAST	331	40,2616	56 155 0	XCH	MPAC +1
1209	REF	94	LAST	331	40,2617	54 154 0	TS	MPAC
1210	REF	2	LAST	331	40,2620	0 2606 0	TC	SCOUTEND
1211	REF	2	LAST	331	40,2621	0 2627 0	DP2OUTSF	TC DPOUT
1212	REF	3	LAST	331	40,2622	0 2606 0	TC	SCOUTEND
1213	REF	3	LAST	331	40,2623	0 2627 0	DP3OUTSF	TC DPOUT
1214	REF	12	LAST	322	40,2624	3 6211 0	CAP	SIX
1215	REF	1			40,2625	0 3056 1	TC	TRIPLEIN
1216	REF	4	LAST	331	40,2626	0 2606 0	TC	SCOUTEND
12165	REF	95	LAST	331	0162		MPAC+6	= MPAC +6
								USE MPAC +6 INSTEAD OF OVIND

L PINBALL GAME BUTTONS AND LIGHTS

USERS PAGE NO. 31 E0 S4

1217 REF 71 LAST 330 40,2627 56 002 0 DPOUT XCH Q
 1218 REF 1 40,2630 54 162 0 TS MPAC+6
 1219 REF 1 40,2631 0 2653 0 TC READLO
 1220 REF 2 LAST 240 40,2632 0 7226 0 TC TPAGREE
 1221 REF 2 LAST 312 40,2633 0 7052 1 TC DMP
 1222 REF 12 LAST 331 40,2634 00123 1 ADRES SPTEMP1
 1223 REF 2 LAST 332 40,2635 0 0162 1 TC MPAC+6
 R12231 THE FOLLOWING ROUTINE DISPLAYS TWO CONTIGUOUS SP POSITIVE INTEGERS
 R12232 AS TWO POSITIVE DECIMAL INTEGERS IN RxD1-RxD2 AND RxD4-RxD5 (RxD3 IS
 R12233 BLANKED). THE INTEGER IN THE LOWER NUMBERED ADDRESS IS DISPLAYED IN
 R12234 RxD1-RxD2.

GET FRESH DATA FOR BOTH HI AND LO.
 MAKE DP DATA AGREE

12235 REF 3 LAST 323 40,2636 0 2437 0 2INTOUT TC 5BLANK
 122355 REF 2 LAST 314 40,2637 0 2314 0 TC +ON
 12236 REF 96 LAST 331 40,2640 3 0154 1 CA MPAC
 12237 REF 1 40,2641 0 3211 0 TC DSPDECVN
 122371 REF 10 LAST 328 40,2642 4 8214 1 CS THREE
 122372 REF 9 LAST 329 40,2643 50 117 0 INDEX DECOUNT
 122373 REF 7 LAST 328 40,2644 6 4333 0 AD R1D1
 122374 REF 30 LAST 329 40,2645 54 777 1 TS DSPCOUNT
 122375 REF 2 LAST 332 40,2646 0 2653 0 TC READLO
 122376 REF 97 LAST 332 40,2647 3 0155 0 CA MPAC +1
 122377 REF 2 LAST 332 40,2650 0 3211 0 TC DSPDECVN
 122378 REF 20 LAST 331 40,2651 0 4574 0 TC POSTJUMP
 122379 REF 3 LAST 331 40,2652 62565 0 CADR DSPDCEND +2
 R1224 READLO PICKS UP FRESH DATA FOR BOTH HI AND LO AND LEAVES IT IN
 R1225 MPAC, MPAC+1. THIS IS NEEDED FOR TIME DISPLAY. IT ZEROES MPAC+2, BUT
 R1226 DOES NOT FORCE TPAGREE.

TO BLANK RxD3
 TURN ON + SIGN
 DISPLAY 1ST INTEGER (LIKE VERB AND NOUN)
 RxD4
 GET 2ND INTEGER
 DISPLAY 2ND INTEGER (LIKE VERB AND NOUN)

1227 REF 72 LAST 332 40,2653 56 002 0 READLO XCH Q
 1228 REF 6 LAST 69 40,2654 54 144 1 TS TEM4
 1229 REF 7 LAST 329 40,2655 50 140 1 INDEX MIXBR
 1230 40,2656 0 2656 0 TC +0
 1231 REF 1 40,2657 0 2673 1 TC RDLQNR
 1232 REF 10 LAST 332 40,2660 50 117 0 INDEX DECOUNT
 1233 REF 3 LAST 322 40,2661 3 0150 0 CA IDAD1TEM
 1234 REF 4 LAST 322 40,2662 7 4372 1 MASK LOW11
 1235 REF 2 LAST 322 40,2663 0 4327 0 TC SETEBANK
 1236 40,2664 0 0006 1 READLO1 EXTEND
 1237 REF 100 LAST 330 40,2665 5 0000 1 INDEX A
 1238 40,2666 3 0001 0 DCA 0
 1239 REF 98 LAST 332 40,2667 52 155 1 DXCH MPAC
 1240 REF 44 LAST 330 40,2670 3 4714 1 CAF ZERO
 1241 REF 99 LAST 332 40,2671 54 156 1 TS MPAC +2
 1242 REF 9 LAST 332 40,2672 0 0144 0 TC TEM4
 1243 REF 10 LAST 328 40,2673 3 0145 1 RDLQNR CA NOINADD
 1244 REF 1 40,2674 0 2664 1 ENDROLO TC READLO1

GET IDADDTAB ENTRY FOR COMP K OF NOUN.
 E SUBK
 SET EB, LEAVE EADRES IN A.
 MIXED NORMAL
 C(ESUBK) C(E)
 C((E SUBK)+1) C(E+1)

E



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 32 E0 84

1245				42,3143			BANK	42	
124501	REF	2	LAST	285	42,2000		SETLOC	PINBALL3	
124502					42,3143		BANK		
12455	REF	1					COUNT	42/PIN	
1246	REF	41	LAST	329	42,3143	0 4555 0	HMSOUT	TC	BANKCALL
1247	REF	3	LAST	332	42,3144	60853 1	CADR	READLO	READ FRESH DATA FOR HI AND LO INTO MPAC, MPAC+1.
1248	REF	3	LAST	332	42,3145	0 7226 0	TC	TPAGEEE	MAKE DP DATA AGREE
1249	REF	1			42,3146	0 3332 0	TC	SEPSECONR	LEAVE PRACF SEC/60 IN MPAC, MPAC+1. LEAVE WHOLE MIN IN BIT13 OF LOTEMOUT AND ABOVE
A1250									USE ONLY PRACF SEC/60 MOD 60
1251	REF	3	LAST	332	42,3147	0 7052 1	TC	DMP	MULT BY .06
1252	REF	1			42,3150	03204 1	ADRES	SECON2	GIVES CENTI-SEC/10EXPS MOD 60
1253	REF	4	LAST	323	42,3151	3 4335 0	CAP	R3D1	
1254	REF	31	LAST	332	42,3152	54 777 1	TS	DSPCOUNT	
1255	REF	42	LAST	333	42,3153	0 4555 0	TC	BANKCALL	DISPLAY SEC MOD 60
1256	REF	2	LAST	329	42,3154	61131 0	CADR	DSPDECD	
1257	REF	1			42,3155	0 3350 1	TC	SEPMIN	REMOVE REST OF SECONDS
1258	REF	1			42,3156	3 3206 0	CAP	MINCON2	LEAVE PRACF MIN/60 IN MPAC+1. LEAVE WHOLE HOURS IN MPAC.
1259	REF	100	LAST	332	42,3157	56 154 1	XCH	MPAC	SAVE WHOLE HOURS.
1260	REF	1			42,3160	55-007 0	TS	HITEMOUT	
1261	REF	2	LAST	333	42,3161	3 3207 1	CAP	MINCON2 +1	USE ONLY PRACF MIN/60 MOD 60
1262	REF	101	LAST	333	42,3162	56 155 0	XCH	MPAC +1	IF C(A) = -0, SHORIMP FAILS TO GIVE -0.
1263	REF	3	LAST	331	42,3163	0 4431 0	TC	PRSHRIMP	MULT BY .0006
A1264									GIVES MIN/10EXPS MOD 60
1265	REF	3	LAST	323	42,3164	3 4334 1	CAP	R2D1	
1266	REF	32	LAST	333	42,3165	54 777 1	TS	DSPCOUNT	DISPLAY MIN MOD 60
1267	REF	43	LAST	333	42,3166	0 4555 0	TC	BANKCALL	
1268	REF	3	LAST	333	42,3167	61131 0	CADR	DSPDECD	MINUTES, SECONDS HAVE BEEN REMOVED
1269					42,3170	0 0006 1	EXTEND		
1270	REF	1			42,3171	3 3213 1	DCA	HRCN1	
1271	REF	102	LAST	333	42,3172	52 155 1	DXCH	MPAC	USE WHOLE HOURS
1272	REF	2	LAST	333	42,3173	3 1007 1	CA	HITEMOUT	IF C(A) = -0, SHORIMP FAILS TO GIVE -0.
1273	REF	4	LAST	333	42,3174	0 4431 0	TC	PRSHRIMP	MULT BY .16384
A1274									GIVES HOURS/10EXPS
1275	REF	8	LAST	332	42,3175	3 4333 0	CAP	R1D1	
1276	REF	33	LAST	333	42,3176	54 777 1	TS	DSPCOUNT	USE REGULAR DSPDECD, WITH ROUND OFF.
1277	REF	44	LAST	333	42,3177	0 4555 0	TC	BANKCALL	
1278	REF	4	LAST	333	42,3200	61131 0	CADR	DSPDECD	
1279	REF	5	LAST	329	42,3201	0 0136 0	TC	ENTEXIT	
1280					42,3202	25660 0	SECON1	ZDEC*	1.666666666 E-4 B12* 2EXP12/6000
1280					42,3203	31742 1			
1281					42,3204	01727 1	SECON2	OCT	01727 .06 FOR SECONDS DISPLAY
1282					42,3205	01217 1		OCT	01217
1283					42,3206	00011 1	MINCON2	OCT	00011 .0006 FOR MINUTES DISPLAY
1284					42,3207	32445 0		OCT	32445
1285					42,3210	02104 0	MINCON1	OCT	02104 .066...66 UPPEED BY 2EXP-28
1286					42,3211	10422 1		OCT	10422
1287					42,3212	05174 0	HRCN1	ZDEC	.16384
1287					42,3213	13261 0			



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 33 E0 S4

1288				42,3214	00000 1		OCT	00000	
1289				42,3215	00062 0	RNDCCN	OCT	00082	
1290	REP	45	LAST	333	42,3218	0 4555 0	M/SCOUT	TC	BANKCALL
1291	REP	4	LAST	333	42,3217	80853 1		CADR	READLO
1292	REP	4	LAST	333	42,3220	0 7226 0		TC	TPAGREE
1293	REP	103	LAST	333	42,3221	10 154 0		CCS	MPAC
1294					42,3222	0 3224 0		TC	+2
1295	REP	1			42,3223	0 3255 0		TC	M/SNORM
1296	REP	1			42,3224	6 3312 1		AD	M/SCON1
1297	REP	101	LAST	332	42,3225	10 000 0		CCS	A
1298	REP	1			42,3226	0 3241 0		TC	M/SLIMIT
1299	REP	2	LAST	334	42,3227	0 3255 0		TC	M/SNORM
1300	REP	3	LAST	334	42,3230	0 3255 0		TC	M/SNORM
1301	REP	104	LAST	334	42,3231	10 155 1		CCS	MPAC +1
1302					42,3232	0 3234 1		TC	+2
1303	REP	4	LAST	334	42,3233	0 3255 0		TC	M/SNORM
1304	REP	1			42,3234	8 3313 0		AD	M/SCON2
1305	REP	102	LAST	334	42,3235	10 000 0		CCS	A
1306	REP	2	LAST	334	42,3238	0 3241 0		TC	M/SLIMIT
1307	REP	5	LAST	334	42,3237	0 3255 0		TC	M/SNORM
1308	REP	6	LAST	334	42,3240	0 3255 0		TC	M/SNORM
1309	REP	105	LAST	334	42,3241	10 154 0	M/SLIMIT	CCS	MPAC
1310	REP	1			42,3242	3 3315 0		CAP	M/SCON3
1311	REP	1			42,3243	0 3252 1		TC	+LIMIT
1312	REP	2	LAST	334	42,3244	4 3315 1		CS	M/SCON3
1313	REP	108	LAST	334	42,3245	54 154 0		TS	MPAC
1314	REP	3	LAST	334	42,3246	4 3316 1		CS	M/SCON3 +1
1315	REP	107	LAST	334	42,3247	54 155 1	LIMITCOM	TS	MPAC +1
1316	REP	1			42,3250	3 3314 1		CAP	NORMADR
1317	REP	2	LAST	333	42,3251	0 3333 1		TC	SEPSECN +1
1318	REP	108	LAST	334	42,3252	54 154 0	+LIMIT	TS	MPAC
1319	REP	4	LAST	334	42,3253	3 3316 0		CAP	M/SCON3 +1
1320	REP	1			42,3254	0 3247 0		TC	LIMITCOM
1321	REP	1			42,3255	0 3317 1	M/SNORM	TC	SEPSEC
A1322									
1323	REP	1			42,3256	3 3310 0		CAP	HISECON
1324	REP	5	LAST	331	42,3257	0 7256 1		TC	SHORTMP
1325	REP	11	LAST	332	42,3260	4 8214 1		CS	THREE
1326	REP	34	LAST	333	42,3261	26 777 1		ADS	DSPCQNT
1327	REP	46	LAST	334	42,3282	0 4555 0		TC	BANKCALL
1328	REP	1			42,3263	81171 1		CADR	DSPDC2NR
1329	REP	45	LAST	332	42,3264	3 4714 1		CAP	ZERO
1330	REP	5	LAST	317	42,3265	54 124 1		TS	CODE
1331	REP	14	LAST	330	42,3266	4 4711 0		CS	TWO
1332	REP	11	LAST	332	42,3267	50 117 0		INDEX	DECOQNT
1333	REP	9	LAST	333	42,3270	8 4333 0		AD	R1D1
1334	REP	3	LAST	317	42,3271	54 143 0		TS	COUNT
1335	REP	47	LAST	334	42,3272	0 4555 0		TC	BANKCALL

.5 SEC
READ FRESH DATA FOR HI AND LO INTO MPAC,
MPAC+1.
MAKE DP DATA AGREE
IF MAG OF (MPAC, MPAC+1) G/ 59 M 59 S,
DISPLAY 59B59, WITH PROPER SIGN.
MPAC = +0. L/ 59M58.5S
- HI PART OF (59M58.5S) +1 FOR CCS
MAG OF MPAC - HI PART OF (59M58.5S)
G/ 59M58.5S
ORIGINAL MPAC = -0. L/ 59M58.5S
L/ 59M58.5S
MAG OF MPAC = HI PART OF 59M58.5S
MPAC+1 = +0. L/ 59M58.5S
- LO PART OF (59M58.5S) +1 FOR CCS
MAG OF MPAC+1 - LO PART OF (59M58.5S)
G/ 59M58.5S
ORIGINAL MPAC+1 = -0. L/ 59M58.5S
L/ 59M58.5S
= 59M58.5S LIMIT
MPAC CANNOT BE +/- 0 AT THIS POINT.
FORCE MPAC, MPAC+1 TO +/- 59M58.5S
WILL DISPLAY 59M59S IN DSPDECONR

SET RETURN TO M/SNORM+1.

LEAVE FRACT SEC/80 IN MPAC, MPAC+1. LEAVE
WHOLE MIN IN BIT13 OF LOTEMOUT AND ABOVE
USE ONLY FRACT SEC/60 MOD 60
MULT BY .8 + 2EXP-14
GIVES SEC/100 MOD 60
DSPCQNT ALREADY SET TO RxD1
DISPLAY SEC MOD 80 IN D4D5.

RxD3

BLANK MIDDLE CHAR



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 34 E0 84

1336	REP	3	LAST	317	42,3273	61225 0	CADR	DSPIN		
1337	REP	2	LAST	333	42,3274	0 3350 1	TC	SSPMIN		REMOVE REST OF SECONDS
1338	REP	109	LAST	334	42,3275	58 155 0	XCH	MPAC	+1	LEAVE FRACT MIN/60 IN MPAC+1
1339					42,3276	0 0008 1	EXTEND			USE ONLY FRACT MIN/60 MOD 60
1340	REP	1			42,3277	7 3311 0	MP	HIMINCON		MULT BY .6 + 2EXP-7
1341	REP	110	LAST	335	42,3300	52 155 1	DXCH	MPAC		GIVES MIN/100 MOD 60
1342	REP	12	LAST	334	42,3301	50 117 0	INDEX	DECOUNT		
1343	REP	10	LAST	334	42,3302	3 4333 0	CAP	R1D1		RxD1
1344	REP	35	LAST	334	42,3303	54 777 1	TS	DSPCOUNT		
1345	REP	48	LAST	334	42,3304	0 4555 0	TC	BANKCALL		DISPLAY MIN MOD 60 IN D1D2.
1346	REP	2	LAST	334	42,3305	61171 1	CADR	DSPDC2NR		
1347	REP	21	LAST	332	42,3308	0 4574 0	TC	POSTJUMP		
1348	REP	4	LAST	332	42,3307	62565 0	CADR	DSPDCEND	+2	
1349					42,3310	23147 1	HISECON	OCT	23147	.6 + 2EXP-14
1350					42,3311	23348 1	HIMINCON	OCT	23348	.6 + 2EXP-7
1351					42,3312	77753 0	M/SCON1	OCT	77753	- HI PART OF (59M58.5S) +1
1352					42,3313	41128 1	M/SCON2	OCT	41128	- LO PART OF (59M58.5S) +1
1353	REP	7	LAST	334	42,3314	03258 0	NORMADR	ADRES	M/SNORM +1	
1354					42,3315	00025 0	M/SCON3	OCT	00025	59M 59.5S
1355					42,3316	37018 1		OCT	37018	
1356	REP	111	LAST	335	42,3317	10 155 1	SEPSEC	CCS	MPAC	+1
1357	REP	1			42,3320	1 3327 0	TOP	POSEC		IF +, ROUND BY ADDING .5 SEC
1358	REP	2	LAST	335	42,3321	1 3327 0	TOP	POSEC		IF -, ROUND BY SUBTRACTING .5 SEC
1359					42,3322	1 3323 1	TOP	+1		FINDS TIME IN MPAC, MPAC+1
1360					42,3323	0 0008 1	EXTEND			ROUNDS OFF BY +/- .5 SEC
1361	REP	1			42,3324	4 3215 0	DCS	RNDCON	-1	LEAVES WHOLE MIN IN BIT13 OF
1362	REP	112	LAST	335	42,3325	20 155 1	SEPSEC1	DAS	MPAC	LOTENOUT AND ABOVE.
1363	REP	3	LAST	334	42,3326	1 3332 1	TOP	SEPSECNR		LEAVES FRACT SEC/60 IN MPAC, MPAC+1.
1364					42,3327	0 0008 1	POSEC	EXTEND		
1365	REP	2	LAST	335	42,3330	3 3215 1	DCA	RNDCON	-1	
1366	REP	1			42,3331	1 3325 1	TOP	SEPSEC1		
1367	REP	73	LAST	332	42,3332	58 002 0	SEPSECNR	XCH	0	THIS ENTRY AVOIDS ROUNDING BY .5 SEC
1368	REP	1			42,3333	54 144 1	TS	SEPSCRET		
1369	REP	4	LAST	333	42,3334	0 7052 1	TC	DMP		MULT BY 2EXP12/6000
1370	REP	1			42,3335	03202 1	ADRES	SECQ1		GIVES FRACT SEC/60 IN BIT12 OF MPAC+1
1371					42,3336	0 0008 1	EXTEND			AND BELOW.
1372	REP	113	LAST	335	42,3337	3 0155 0	DCA	MPAC		SAVE MINUTES AND HOURS
1373	REP	3	LAST	333	42,3340	53-010 0	DXCH	HITEMOUT		
1374	REP	1			42,3341	0 4420 0	TC	TPSL1		
1375	REP	2	LAST	335	42,3342	0 4420 0	TC	TPSL1		GIVES FRACT SEC/60 IN MPAC+1, MPAC+2.
1376	REP	48	LAST	334	42,3343	3 4714 1	CAP	ZERO		
1377	REP	114	LAST	335	42,3344	58 158 0	XCH	MPAC	+2	
1378	REP	115	LAST	335	42,3345	58 155 0	XCH	MPAC	+1	LEAVE FRACT SEC/60 IN MPAC, MPAC+1.
1379	REP	116	LAST	335	42,3346	58 154 1	XCH	MPAC		
1380	REP	2	LAST	335	42,3347	0 0144 0	TC	SEPSCRET		

L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 35 E0 S4

1381	REP	74	LAST	335	42,3350	56 002 0-	SEPMIN	XCH	0		
1382	REP	1			42,3351	54 144 1		TS	SEPMNRET		FINDS WHOLE MINUTES IN BIT13
1383	REP	1			42,3352	3 1010 1		CA	LOTENOUT		OF LOTENOUT AND ABOVE.
1384					42,3353	0 0006 1					REMOVES REST OF SECONDS.
1385	REP	13	LAST	183	42,3354	7 4710 1		EXTEND			LEAVES FRACT MIN/60 IN MPAC+1.
1386					42,3355	0 0006 1		MP	BIT3		LEAVES WHOLE HOURS IN MPAC.
1387	REP	17	LAST	193	42,3356	7 4676 0		EXTEND			SR 12, THROW AWAY LP.
1388	REP	117	LAST	335	42,3357	22 155 0		MP	BIT13		SR 2, TAKE FROM LP. = SL 12.
A1389								LXCH	MPAC	+1	THIS FORCES BITS 12-1 TO 0 IF +,
1390	REP	4	LAST	335	42,3360	3 1007 1					FORCES BITS 12-1 TO 1 IF -.
1391	REP	118	LAST	336	42,3361	54 154 0		CA	HITEMOUT		
1392	REP	5	LAST	335	42,3362	0 7052 1		TS	MPAC		
1393	REP	1			42,3363	03210 1		TC	DMP		MULT BY 1/15
1394	REP	2	LAST	336	42,3364	0 0144 0	ENDSPMIN	ADRES	MINCON1		GIVES FRACT MIN/60 IN MPAC+1.
R1395								TC	SEPMNRET		GIVES WHOLE HOURS IN MPAC.
R1396											
R1397											
R1398											
R1399											
R1400											
1401	REP	1			40,2675						
								SETLOC	ENDROLO	+1	
14015	REP	3	LAST	330 TO	333'	111 445*		COUNT	40/PIN		
1402	REP	8	LAST	332	40,2675	50 140 1	DSPDPDEC	INDEX	MIXBR		
1403					40,2676	0 2676 1		TC	+0		
1404					40,2677	0 2701 0		TC	+2		
1405	REP	3	LAST	324	40,2700	0 3323 0		TC	DSPALARM		NORMAL NOUN
1406					40,2701	0 0006 1		EXTEND			
1407	REP	11	LAST	332	40,2702	5 0145 1		INDEX	NOUNADO		
1408					40,2703	3 0001 0		DCA	0		
1409	REP	119	LAST	336	40,2704	52 155 1		DXCH	MPAC		
1410	REP	11	LAST	335	40,2705	3 4333 0		CAP	R1D1		
1411	REP	36	LAST	335	40,2706	54 777 1		TS	DSPCOUNT		
1412	REP	47	LAST	335	40,2707	3 4714 1		CAP	ZERO		
1413	REP	120	LAST	336	40,2710	54 156 1		TS	MPAC	+2	
1414	REP	5	LAST	334	40,2711	0 7226 0		TC	TPAGREE		
1415	REP	1			40,2712	0 3176 1		TC	DSP2DEC		
1416	REP	6	LAST	333	40,2713	0 0136 0	ENDDPDEC	TC	ENTEXIT		



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 36

EO 84

P1417 LOAD VERBS IF ALARM CONDITION IS DETECTED DURING EXECUTE,
R1418 CHECK FAIL LIGHT IS TURNED ON AND ENDJOB. IF ALARM CONDITION IS
R1419 DETECTED DURING ENTER OF DATA, CHECK FAIL IS TURNED ON AND IT RECYCLES
R1420 TO EXECUTE OF ORIGINAL LOAD VERB. RECYCLE CAUSED BY 1) DECIMAL MACHINE
R1421 CADR 2) MIXTURE OF OCTAL/DECIMAL DATA 3) OCTAL DATA INTO DECIMAL
R1422 ONLY NOUN 4) DEC DATA INTO OCT ONLY NOUN 5) DATA TOO LARGE FOR SCALE
R1423 6) FEWER THAN 3 DATA WORDS LOADED FOR HRS, MIN, SEC NOUN.8(2)-(6) ALARM
R1424 AND RECYCLE OCCUR AT FINAL ENTER OF SET. (1) ALARM AND RECYCLE OCCUR AT
R1425 ENTER OF CADR.

1426	REP	1		41,2612		SETLOC ENDROUT	
14265	REP	2	LAST	318 TO 330	394 394*	COUNT	41/PIN
1427	REP	15	LAST	334	41,2612 4 4711 0	ABCLD	CS TWO
1428	REP	3	LAST	326	41,2613 0 2423 0	TC	COMPTST
1429	REP	1			41,2614 0 2457 0	TC	NOUNTEST
1430	REP	1			41,2615 3 3001 0	CAP	VBSP1LD
1431	REP	2	LAST	316	41,2616 0 2336 0	TC	UPDATVB -1
1432	REP	1			41,2617 0 2302 1	TC	REQDATX
1433	REP	1			41,2620 3 3002 0	CAP	VBSP2LD
1434	REP	3	LAST	337	41,2621 0 2336 0	TC	UPDATVB -1
1435	REP	1			41,2622 0 2304 1	TC	REQDATY
1436	REP	1			41,2623 3 3003 1	CAP	VBSP3LD
1437	REP	4	LAST	337	41,2624 0 2336 0	TC	UPDATVB -1
1438	REP	2	LAST	319	41,2625 0 2306 0	TC	REQDATZ
1439	REP	13	LAST	331	41,2626 4 6211 1	PUTXYZ	CS SIX
1440	REP	1			41,2627 0 3004 0	TC	ALLDC/OC
1441					41,2630 0 0006 1	EXTEND	
1442	REP	4	LAST	323	41,2631 3 2114 1	DCA	LODNNLOC
1443	REP	7	LAST	329	41,2632 52 008 0	DXCH	Z
1444	REP	46	LAST	336	41,2633 3 4714 1	CAP	ZERO
1445	REP	1			41,2634 0 3070 0	TC	PUTCOM
1446	REP	12	LAST	336	41,2635 50 145 1	INDEX	NOUNADD
1447					41,2636 54 000 0	TS	0
1448	REP	29	LAST	330	41,2637 3 4712 1	CAP	ONE
1449	REP	2	LAST	337	41,2640 0 3070 0	TC	PUTCOM
1450	REP	13	LAST	337	41,2641 50 145 1	INDEX	NOUNADD
1451					41,2642 54 001 1	TS	1
1452	REP	16	LAST	337	41,2643 3 4711 1	CAP	TWO
1453	REP	3	LAST	337	41,2644 0 3070 0	TC	PUTCOM
1454	REP	14	LAST	337	41,2645 50 145 1	INDEX	NOUNADD
1455					41,2646 54 002 1	TS	2
145501	REP	5	LAST	225	41,2647 4 4716 1	CS	SEVEN
145502	REP	10	LAST	323	41,2650 6 1002 1	AD	NOUNREG
145503					41,2651 0 0006 1	EXTEND	
145504					41,2652 1 2654 0	BZF	+2

TEST IF NOUN CAN BE LOADED.

TEST THAT THE 3 DATA WORDS LOADED ARE ALL DEC OR ALL OCT.

SWITCH BANKS TO NOUN TABLE READING ROUTINE.
X COMP

Y COMP

Z COMP

IF NOUN 7 HAS JUST BEEN LOADED, SET FLAG BITS AS SPECIFIED.



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 37 E0 S4

145505	REF	2	LAST	318	41,2653	0	2771	1	TC	LOADLV	
145506	REF	4	LAST	328	41,2654	3	1003	0	CA	XREG	
145507	REF	5	LAST	323	41,2655	0	4320	1	TC	SETINCADR +1	ECADR OF FLAG WORD.
145508	REF	2	LAST	319	41,2656	3	1005	0	CA	ZREG	SET EBANK, NOUNADD.
145509					41,2657	0	0004	0			ZERO TO RESET BITS, NON-ZERO TO SET BITS
14551					41,2660	0	0006	1	INHINT		
145511	REF	1			41,2661	1	2670	0	EXTEND		
145512	REF	15	LAST	337	41,2662	50	145	1	BZF	BITSOFF	
145513					41,2663	4	0000	0	INDEX	NOUNADD	
145514	REF	1			41,2684	7	1004	0	CS	0	
145515	REF	16	LAST	338	41,2665	50	145	1	MASK	YREG	BITS TO BE PROCESSED.
145516					41,2666	26	000	0	INDEX	NOUNADD	
145517	REF	1			41,2667	0	2675	1	ADS	0	SET BITS.
145518	REF	2	LAST	338	41,2670	4	1004	0	TC	BITSOFF1	
145519	REF	17	LAST	336	41,2671	50	145	1	CS	YREG	BITS TO BE PROCESSED.
14552					41,2672	7	0000	0	INDEX	NOUNADD	
145521	REF	18	LAST	338	41,2673	50	145	1	MASK	0	
145522					41,2674	54	000	0	INDEX	NOUNADD	
145523					41,2675	0	0003	1	TS	0	RESET BITS.
1456	REF	3	LAST	338	41,2676	0	2771	1	BITSOFF1	RELINT	
									TC	LOADLV	
1457	REF	30	LAST	337	41,2677	4	4712	0	ABLOAD	CS	ONE
1458	REF	4	LAST	337	41,2700	0	2423	0	TC	COMPTST	
1459	REF	2	LAST	337	41,2701	0	2457	0	TC	NOUNTEST	TEST IF NOUN CAN BE LOADED.
1460	REF	2	LAST	337	41,2702	3	3001	0	CAP	VBSPI1D	
1461	REF	5	LAST	337	41,2703	0	2336	0	TC	UPDATVB -1	
1462	REF	2	LAST	337	41,2704	0	2302	1	TC	REQDATX	
1463	REF	2	LAST	337	41,2705	3	3002	0	CAP	VBSPI2D	
1464	REF	6	LAST	338	41,2706	0	2336	0	TC	UPDATVB -1	
1465	REF	2	LAST	337	41,2707	0	2304	1	TC	REQDATY	
1466	REF	6	LAST	320	41,2710	4	4715	1	PUTXY	CS	FIVE
1467	REF	2	LAST	337	41,2711	0	3004	0	TC	ALLDC/OC	TEST THAT THE 2 DATA WORDS LOADED ARE ALL DEC OR ALL OCT.
1468					41,2712	0	0006	1	EXTEND		
1469	REF	5	LAST	337	41,2713	3	2114	1	DCA	LODNNLOC	SWITCH BANKS TO NOUN TABLE READING ROUTINE.
1470	REF	6	LAST	337	41,2714	52	006	0	DXCH	Z	X COMP
1471	REF	49	LAST	337	41,2715	3	4714	1	CAP	ZERO	
1472	REF	4	LAST	337	41,2716	0	3070	0	TC	PUTCOM	
1473	REF	19	LAST	338	41,2717	50	145	1	INDEX	NOUNADD	
1474					41,2720	54	000	0	TS	0	
1475	REF	31	LAST	338	41,2721	3	4712	1	CAP	ONE	Y COMP
1476	REF	5	LAST	338	41,2722	0	3070	0	TC	PUTCOM	
1477	REF	20	LAST	338	41,2723	50	145	1	INDEX	NOUNADD	
1478					41,2724	54	001	1	TS	1	
1479	REF	4	LAST	338	41,2725	0	2771	1	TC	LOADLV	
1481	REF	3	LAST	338	41,2726	0	2302	1	ALOAD	TC	REQDATX
1482					41,2727	0	0006	1	EXTEND		
1483	REF	6	LAST	338	41,2730	3	2114	1	DCA	LODNNLOC	SWITCH BANKS TO NOUN TABLE READING ROUTINE.
1484	REF	9	LAST	338	41,2731	52	006	0	DXCH	Z	X COMP
1485	REF	50	LAST	338	41,2732	3	4714	1	CAP	ZERO	



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 36

E0 S4

1486	REP	6	LAST	338	41,2733	0 3070 0	TC	PUTCOM
1487	REP	21	LAST	338	41,2734	50 145 1	INDEX	NOUNADD
1488					41,2735	54 000 0	TS	0
1489	REP	5	LAST	338	41,2738	0 2771 1	TC	LOADLV
1490	REP	32	LAST	336	41,2737	4 4712 0	BLOAD	CS ONE
1491	REP	5	LAST	336	41,2740	0 2423 0	TC	COMPIEST
1493	REP	24	LAST	330	41,2741	3 4674 0	CAP	BIT15
1494	REP	10	LAST	319	41,2742	55=015 0	TS	CLPASS
1495	REP	3	LAST	338	41,2743	0 2304 1	TC	REQDATY
1496					41,2744	0 0006 1	EXTEND	
1497	REP	7	LAST	338	41,2745	3 2114 1	DCA	LODNNLOC
1498	REP	10	LAST	338	41,2746	52 008 0	DXCH	Z
1499	REP	33	LAST	339	41,2747	3 4712 1	CAP	ONE
1500	REP	7	LAST	339	41,2750	0 3070 0	TC	PUTCOM
1501	REP	22	LAST	339	41,2751	50 145 1	INDEX	NOUNADD
1502					41,2752	54 001 1	TS	1
1503	REP	6	LAST	339	41,2753	0 2771 1	TC	LOADLV
1504	REP	17	LAST	337	41,2754	4 4711 0	CLOAD	CS TWO
1505	REP	6	LAST	339	41,2755	0 2423 0	TC	COMPIEST
1507	REP	25	LAST	339	41,2756	3 4674 0	CAP	BIT15
1508	REP	11	LAST	339	41,2757	55=015 0	TS	CLPASS
1509	REP	3	LAST	337	41,2760	0 2308 0	TC	REQDATZ
1510					41,2761	0 0006 1	EXTEND	
1511	REP	6	LAST	339	41,2762	3 2114 1	DCA	LODNNLOC
1512	REP	11	LAST	339	41,2763	52 006 0	DXCH	Z
1513	REP	18	LAST	339	41,2764	3 4711 1	CAP	TWO
1514	REP	8	LAST	339	41,2765	0 3070 0	TC	PUTCOM
1515	REP	23	LAST	339	41,2766	50 145 1	INDEX	NOUNADD
1516					41,2767	54 002 1	TS	2
1517	REP	7	LAST	339	41,2770	0 2771 1	TC	LOADLV
1518	REP	51	LAST	338	41,2771	3 4714 1	LOADLV	CAP ZERO
1519	REP	13	LAST	319	41,2772	55=000 1	TS	DECBRNCH
1520	REP	52	LAST	339	41,2773	4 4714 0	CS	ZERO
1521	REP	1			41,2774	55=014 1	TS	LOADSTAT
1522	REP	6	LAST	323	41,2775	4 4374 1	CS	VD1
1523	REP	37	LAST	336	41,2776	54 777 1	TS	DSPCOUNT
1524	REP	22	LAST	335	41,2777	0 4574 0	TC	POSTJUMP
1525	REP	1			41,3000	61450 1	CADR	RECALST
1526					41,3001	00025 0	VBSP1LD	DEC 21
1527					41,3002	00026 0	VBSP2LD	DEC 22
1528					41,3003	00027 1	VBSP3LD	DEC 23
1529	REP	13	LAST	335	41,3004	54 117 1	ALLDC/OC	TS DECCOUNT
1530	REP	14	LAST	339	41,3005	4 1000 1	CS	DECBRNCH
1531	REP	6	LAST	317	41,3006	54 021 0	TS	SR

SET CLPASS FOR PASS0 ONLY

SWITCH BANKS TO NOUN TABLE READING ROUTINE.

SET CLPASS FOR PASS0 ONLY

SWITCH BANKS TO NOUN TABLE READING ROUTINE.

TO BLOCK NUMERICAL CHARACTERS AND
CLEARS AFTER A COMPLETED LOAD
AFTER COMPLETED LOAD, GO TO RECALST
TO SEE IF THERE IS RECALL FROM ENDIDLE.

VB21 = ALOAD

VB22 = BLOAD

VB23 = CLOAD

TESTS THAT DATA WORDS LOADED ARE EITHER
ALL DEC OR ALL OCT. ALARMS IF NOT.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 39 E0 34

1532	REF	7	LAST	339	41,3007	4 0021 0	CS	SR
1533	REF	8	LAST	340	41,3010	4 0021 0	CS	SR
1534	REF	103	LAST	334	41,3011	10 000 0	CCS	A
1535					41,3012	1 3014 0	TC	+2
1536	REF	75	LAST	336	41,3013	0 0002 0	TC	Q
1537	REF	14	LAST	339	41,3014	6 0117 0	AD	DECOUNT
1538					41,3015	0 0006 1	EXTEND	
1539					41,3016	1 3020 1	BZF	+2
1540	REF	4	LAST	327	41,3017	0 4181 0	TC	ALMCYCLE
1541	REF	76	LAST	340	41,3020	0 0002 0	GOO	TC
1542	REF	77	LAST	340	41,3021	56 002 0	SPRUTINOR	XCH
1543	REF	1			41,3022	54 114 1	TS	EXITEM
1544	REF	1			41,3023	3 4363 0	CAP	MID5
1545	REF	3	LAST	328	41,3024	7 0147 1	MASK	NNTYPTM
1546	REF	1			41,3025	0 4336 0	TC	RIGHTS
1547	REF	2	LAST	340	41,3026	0 0114 0	TC	EXITEM
1548	REF	76	LAST	340	41,3027	56 002 0	SPRUTIMIX	XCH
1549	REF	3	LAST	340	41,3030	54 114 1	TS	EXITEM
1550	REF	15	LAST	340	41,3031	50 117 0	INDEX	DECOUNT
1551	REF	1			41,3032	3 3061 0	CAP	DISPLACE
1552	REF	38	LAST	328	41,3033	54 001 1	TS	L
1553	REF	16	LAST	340	41,3034	50 117 0	INDEX	DECOUNT
1554	REF	3	LAST	311	41,3035	3 4362 1	CAP	LOW5
1555	REF	2	LAST	265	41,3036	7 0153 1	MASK	RUTMXTEM
1556	REF	37	LAST	340	41,3037	50 001 0	INDEX	L
1557					41,3040	0 0000 1	TC	0
R1558	DO TC	GOO(DECOUNT=0),	DO TC	RIGHTS(DECOUNT=1),	DO TC	LEFTS(DECOUNT=2).		
1559	REF	4	LAST	340	41,3041	0 0114 0	SPRET1	TC
1560	REF	79	LAST	340	41,3042	56 002 0	SPCONUM	XCH
1561	REF	5	LAST	340	41,3043	54 114 1	TS	EXITEM
1562	REF	9	LAST	336	41,3044	50 140 1	INDEX	MIXRR
1563					41,3045	0 3045 0	TC	+0
1564	REF	1			41,3046	0 3064 0	TC	CONUMOR
1565	REF	17	LAST	340	41,3047	50 117 0	INDEX	DECOUNT
1566	REF	2	LAST	340	41,3050	3 3061 0	CAP	DISPLACE
1567	REF	38	LAST	340	41,3051	54 001 1	TS	L
1568	REF	16	LAST	340	41,3052	50 117 0	INDEX	DECOUNT
1569	REF	4	LAST	340	41,3053	3 4362 1	CAP	LOW5
1570	REF	4	LAST	340	41,3054	7 0147 1	MASK	NNTYPTM
1571	REF	39	LAST	340	41,3055	50 001 0	INDEX	L
1572					41,3056	0 0000 1	TC	0
R1573	DO TC	GOO(DECOUNT=0),	DO TC	RIGHTS(DECOUNT=1),	DO TC	LEFTS(DECOUNT=2).		
1574					41,3057	6 0000 1	SPRET	DOUBLE
1575	REF	6	LAST	340	41,3060	0 0114 0	TC	EXITEM
1576	REF	1			41,3061	0 3020 0	DISPLACE	TC

SHIFTED RIGHT 2
 DEC COMP BITS IN LOW 3
 SOME ONES IN LOW 3
 ALL ZEROS. ALL OCTAL. OK
 DEC COMP = 7 FOR 3COMP, =6 FOR 2COMP
 (BUT IT HAS BEEN DECREMENTED BY CCS)
 MUST MATCH 6 FOR 3COMP, 5 FOR 2COMP.
 ALARM AND RECYCLE.
 ALL REQUIRED ARE DEC. OK
 GETS SP ROUTINE NUMBER FOR NORMAL CASE
 CANT USE L FOR RETURN. TSPOROP USES L.

SP ROUTINE NUMBER IN A

GETS SP ROUTINE NUMBER FOR MIXED CASE

PUT TC GOO, TC RIGHTS, OR TC LEFTS IN L

LOW5, MID5, OR HI5 IN A

GET HI5, MID5, OR LOW5 OF RUTMXTAB ENTRY

SP ROUTINE NUMBER IN A

GETS 2X(SP CONSTANT NUMBER)

NORMAL NOUN

MIXED NOUN

PUT TC GOO, TC RIGHTS, OR TC LEFTS IN L

2X(SP CONSTANT NUMBER) IN A



L PINBALL GAME BUTTONS AND LIGHTS

USER=8 PAGE NO. 40

EO S4

REF	REP	LAST	340	41,3062	0 4336 0	TC	RIGHTS			
1577	REF	2	LAST	340	41,3062	0 4336 0	TC	RIGHTS		
1578	REF	3	LAST	328	41,3063	0 4345 1	TC	LEFTS		
1579	REF	5	LAST	340	41,3064	3 4362 1	CONUNOR	CAP	LOW5	NORMAL NOUN ALWAYS GETS LOW 5 OF
1580	REF	5	LAST	340	41,3065	7 0147 1	MASK	NNTYPTM	NNTYPTAB FOR SF CONUM.	
1581	REF	5	LAST	340	41,3066	8 0000 1	DOUBLE			
1582	REF	7	LAST	340	41,3067	0 0114 0	TC	EXITEM	2X(SF CONSTANT NUMBER) IN A	
1583	REF	19	LAST	340	41,3070	54 117 1	PUTCOM	TS	DECOUNT	
1584	REF	80	LAST	340	41,3071	56 002 0	XCH	Q		
1585	REF	1	LAST	340	41,3072	54 115 0	TS	DECRET		
1586	REF	53	LAST	339	41,3073	3 4714 1	CAP	ZERO		
1587	REF	3	LAST	332	41,3074	54 182 0	TS	MPAC+6		
1588	REF	20	LAST	341	41,3075	50 117 0	INDEX	DECOUNT		
1589	REF	3	LAST	317	41,3076	57*008 0	XCH	XREGLP		
1590	REF	121	LAST	336	41,3077	54 155 1	TS	MPAC +1		
1591	REF	21	LAST	341	41,3100	50 117 0	INDEX	DECOUNT		
1592	REF	5	LAST	338	41,3101	57*003 0	XCH	XREG		
1593	REF	122	LAST	341	41,3102	54 154 0	TS	MPAC		
1594	REF	10	LAST	340	41,3103	50 140 1	INDEX	MIXBR		
1595	REF	1	LAST	340	41,3104	0 3104 1	TC	+0		
1596	REF	1	LAST	340	41,3105	0 3132 1	TC	PUTNORM	NORMAL NOUN	
1597	REF	22	LAST	341	41,3106	50 117 0	INDEX	DECOUNT	GET IDADOTAB ENTRY FOR COMPONENT K	
1598	REF	4	LAST	332	41,3107	3 0150 0	CA	IDAD1TEM	OF NOUN.	
1599	REF	5	LAST	332	41,3110	7 4372 1	MASK	LOW11	(ECADR) SUBK FOR CURRENT COMP OF NOUN	
1601	REF	6	LAST	338	41,3111	0 4317 0	TC	SETNOCADR	ECADR INTO NOUNCADR. SETS EB, NOUNADD.	
1602	REF	23	LAST	341	41,3112	0 0006 1	EXTEND		C(NOUNADD) IN A UPON RETURN	
1603	REF	24	LAST	339	41,3113	54 145 0	SU	DECOUNT	PLACE (ESUBK)-K INTO NOUNADD	
1604	REF	15	LAST	339	41,3115	11*000 1	CCS	DECBRNCH		
1605	REF	1	LAST	341	41,3116	0 3165 0	TC	PUTDECSF		
1606	REF	1	LAST	341	41,3117	0 2451 0	TC	DCTSTCYC	+ DEC	
1607	REF	3	LAST	329	41,3120	0 3027 1	TC	SPRUTMIX	+0 OCTAL	
1608	REF	3	LAST	328	41,3121	0 2261 0	TC	DPTTEST	TEST IF DEC ONLY BIT = 1. IF SO,	
1609	REF	1	LAST	341	41,3122	0 3150 0	TC	PUTCOM2	ALARM AND RECYCLE. IF NOT, CONTINUE.	
1610	REF	1	LAST	341	41,3122	0 3150 0	TC	PUTCOM2	NO DP	
1611	REF	25	LAST	341	41,3123	24 145 1	PUTDPCM	INCR	TEST FOR DP SCALE FOR OCT LOAD. IF SO,	
1612	REF	26	LAST	341	41,3124	3 0145 1	CA	NOUNADD	+0 INTO MAJOR PART. SET NOUNADD FOR	
1613	REF	24	LAST	341	41,3125	26 117 1	ADS	DECOUNT	LOADING OCTAL WORD INTO MINOR PART.	
1614	REF	54	LAST	341	41,3126	3 4714 1	CAP	ZERO	DP (ESUBK)-K+1 OR E+1	
1615	REF	25	LAST	341	41,3127	50 117 0	INDEX	DECOUNT	NOUNADD NOW SET FOR MINOR PART	
1616	REF	2	LAST	341	41,3130	53*777 0	TS	0	(ESUBK)+1 OR E+1 INTO DECOUNT	
1617	REF	2	LAST	341	41,3131	0 3150 0	TC	PUTCOM2	NOUNADD SET FOR MINOR PART	
1618	REF	2	LAST	319	41,3132	0 4325 1	PUTNORM	TC	ZERO MAJOR PART(ESUBK OR E)	
1619	REF	16	LAST	341	41,3133	11*000 1	CCS	DECBRNCH	ECADR FROM NOUNCADR. SETS EB, NOUNADD.	



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 41 E0 S4

1623	REP	2	LAST	341	41,3134	0 3185 0	TC	PUTDECSF
1624	REP	2	LAST	341	41,3135	0 2451 0	TC	DOTSTCYC
1625	REP	3	LAST	329	41,3136	0 3021 1	TC	SPRUTNOR
1626	REP	4	LAST	341	41,3137	0 2261 0	TC	DPTEST
1627	REP	3	LAST	341	41,3140	0 3144 0	TC	PUTCOM2 -4
1628	REP	55	LAST	341	41,3141	3 4714 1	CAP	ZERO
1629	REP	26	LAST	341	41,3142	54 117 1	TS	DECOUNT
1630	REP	1			41,3143	0 3123 1	TC	PUTDPCOM
1631	REP	8	LAST	328	41,3144	3 0146 1	CA	NNADTEM
1632	REP	34	LAST	339	41,3145	6 4712 1	AD	ONE
1633					41,3146	0 0006 1	EXTEND	
1634	REP	1			41,3147	1 3154 0	BZF	CHANLOAD
1635	REP	123	LAST	341	41,3150	56 154 1	PUTCOM2	XCH MPAC
1636	REP	2	LAST	341	41,3151	0 0115 1	TC	DECRET
1637	REP	38	LAST	339	0777		EBANK=	DSPCOUNT
1638	REP	1			41,3152	0 2126 0	GTSPINLC	2CADR GTSPIN
1638	REP	1			41,3153	6 4101 0		
1639	REP	6	LAST	337	41,3154	4 4716 1	CHANLOAD	CS SEVEN
16391	REP	4	LAST	326	41,3155	6 1017 0	AD	NOUNCADR
16392					41,3156	0 0006 1	EXTEND	
16393	REP	8	LAST	339	41,3157	1 2771 0	BZF	LOADLV
16394	REP	124	LAST	342	41,3160	3 0154 1	CA	MPAC
1640					41,3161	0 0006 1	EXTEND	
1641	REP	5	LAST	342	41,3162	5 1017 0	INDEX	NOUNCADR
1642					41,3163	01 000 0	WRITE	0
1643	REP	9	LAST	342	41,3164	0 2771 1	TC	LOADLV
R1644	PUTDECSF	FINDS	MIXBR	AND DECOUNT STILL	SET FROM PUTCOM			
1645	REP	2	LAST	328	41,3165	0 3042 1	PUTDECSF	TC SPCONUM
1646	REP	13	LAST	332	41,3166	54 123 0	TS	SPTMP1
1647					41,3167	0 0006 1	EXTEND	
1648	REP	1			41,3170	3 3153 0	DCA	GTSPINLC
1649	REP	12	LAST	339	41,3171	52 006 0	DXCH	Z
1650	REP	11	LAST	341	41,3172	50 140 1	INDEX	MIXBR
1651					41,3173	0 3173 1	TC	+0
1652	REP	1			41,3174	0 3177 0	TC	PUTSFNOR
1653	REP	4	LAST	341	41,3175	0 3027 1	TC	SPRUTMIX
1654	REP	1			41,3176	0 3200 0	TC	PUTDCSF2
1655	REP	4	LAST	342	41,3177	0 3021 1	PUTSFNOR	TC SPRUTNOR
1656	REP	104	LAST	340	41,3200	50 000 1	PUTDCSF2	INDEX A
1657	REP	1			41,3201	3 3203 0	CAP	SPINTABR
1658	REP	3	LAST	329	41,3202	0 4577 0	TC	RANKJUMP
1659	REP	1			41,3203	62347 0	SPINTABR	CADR GOALNCYC

+ DEC
+0 OCTAL
TEST IF DEC ONLY BIT = 1. IF SO,
ALARM AND RECYCLE. IF NOT, CONTINUE.
NO DP
DP

IF NNADTEM = -1, CHANNEL TO BE SPECIFIED

DONT LOAD CHAN 7. (IT = SUPERBANK).

2X(SF CON NUMB) IN A

SWITCH BANKS TO SF CONSTANT TABLE
READING ROUTINE.
LOADS SPTMP1, SPTMP2.

SWITCH BANKS FOR EXPANSION ROOM
ALARM AND RECYCLE IF DEC LOAD.

L PINBALL GAME BUTTONS AND LIGHTS

USERS PAGE NO. 42 E0.54

WITH OCTAL ONLY NOUN.

A1660
 1661 REF 1 41,3204 60774 0 CADR BINROUND
 1662 REF 1 41,3205 60714 0 CADR DEGINSP
 1663 REF 1 41,3206 60764 1 CADR ARTHINSP
 1664 REF 1 41,3207 61017 0 CADR DPINSP
 1665 REF 1 41,3210 61044 0 CADR DPINSP2
 1666 REF 1 41,3211 61002 1 CADR OPTDEGIN
 1667 REF 2 LAST 343 41,3212 61017 0 CADR DPINSP
 1668 REF 1 41,3213 65365 1 CADR HMSIN
 1669 REF 4 LAST 336 41,3214 61323 1 CADR DSPALARM
 1671 REF 1 41,3215 61051 1 CADR DPINSP4
 16711 REF 1 41,3216 60777 0 CADR ARTIN1SP
 16712 REF 5 LAST 343 41,3217 61323 1 CADR DSPALARM
 1672 41,3220 ENDRUTIN EQUALS
 R1673 SCALE FACTORS FOR THOSE ROUTINES NEEDING THEM ARE AVAILABLE IN SFTEMP1.
 R1674 ALL SPIN ROUTINES USE MPAC MPAC+1. LEAVE RESULT IN A. END WITH TC DECRET
 1675 REF 1 40,2714 SETLOC ENDDPDEC +1

SAME AS ARITHDP1

MIN/SEC CANT BE LOADED.

2INTOUT CANT BE LOADED.

16755 REF 4 LAST 336 TO 337 15 460* COUNT 40/PIN

R1676 DEGINSP APPLIES $1000/160 = 5.5555(10) = 5.43434(6)$

1677 REF 6 LAST 336 40,2714 0 7052 1 DEGINSP TC DMP
 1678 REF 1 40,2715 0 2757 0 ADRES DEGCQN1
 1679 REF 125 LAST 342 40,2716 10 155 1 CCS MPAC +1
 1680 REF 15 LAST 315 40,2717 3 4700 1 CAP BIT11
 1681 40,2720 0 2722 1 TC +2
 1682 REF 16 LAST 343 40,2721 4 4700 0 CS BIT11
 1683 REF 126 LAST 343 40,2722 6 0155 0 AD MPAC +1
 1684 REF 1 40,2723 0 3070 0 TC 2ROUND +2
 1685 REF 3 LAST 335 40,2724 0 4420 0 TC TPL1
 1686 REF 4 LAST 343 40,2725 0 4420 0 DEGINSP2 TC TPL1
 1687 REF 1 40,2726 0 3077 1 TC TESTORUP
 1688 REF 5 LAST 343 40,2727 0 4420 0 TC TPL1
 1689 REF 127 LAST 343 40,2730 10 154 0 CCS MPAC
 1690 REF 1 40,2731 0 2735 1 TC SIGNFIX
 1691 REF 2 LAST 343 40,2732 0 2735 1 TC SIGNFIX
 1692 40,2733 4 0000 0 COM
 1693 REF 126 LAST 343 40,2734 54 154 0 TS MPAC
 1694 REF 4 LAST 341 40,2735 10 162 0 SIGNFIX CCS MPAC+6
 1695 REF 1 40,2736 0 2753 1 TC SCNT01
 1696 REF 1 40,2737 0 2747 1 TC ENDSOALE
 1697 REF 129 LAST 343 40,2740 10 154 0 CCS MPAC
 1698 REF 5 LAST 330 40,2741 0 5640 0 TC CCSHOLE
 1699 REF 1 40,2742 0 2751 0 TC NEG180
 1700 40,2743 0 2744 1 TC +1

SF ROUTINE FOR DEC DEGREES
 MULT BY 5.5 $5(10) \times 2EXP-3$
 THIS ROUNDS OFF MPAC+1 BEFORE SHIFT
 LEFT 3, AND CAUSES 360.00 TO OF/UP
 WHEN SHIFTED LEFT AND ALARM.

LEFT 1
 LEFT 2

RETURNS IF NO OF/UP (LEFT3)

IF+, GO TO SIGNFIX
 IF +0, GO TO SIGNFIX
 IF -, USE -MAGNITUDE +1
 IF -0, USE +0

IF OVERFLOW
 NO OVERFLOW/UNDERFLOW
 IF UP FORCE SIGN TO 0 EXCEPT -180

L PINBALL GAME BUTTONS AND LIGHTS

1701	REP	130	LAST	343	40,2744	58 154 1		XCH	MPAC	
1702	REP	7	LAST	299	40,2745	7 4672 1		MASK	POS MAX	
1703	REP	131	LAST	344	40,2748	54 154 0		TS	MPAC	
1704	REP	23	LAST	339	40,2747	0 4574 0	ENDSCALE	TC	POSTJUMP	
1705	REP	4	LAST	342	40,2750	63150 0		CADR	PUTCOM2	
1706	REP	8	LAST	344	40,2751	4 4672 1	NEG180	CS	POS MAX	
1707	REP	2	LAST	343	40,2752	0 2748 0		TC	ENDSCALE	-1
1708	REP	132	LAST	344	40,2753	4 0154 0	SGNTO1	CS	MPAC	
1709	REP	9	LAST	344	40,2754	7 4672 1		MASK	POS MAX	
1710	REP	105	LAST	342	40,2755	4 0000 0		CS	A	
1711	REP	3	LAST	344	40,2756	0 2746 0		TC	ENDSCALE	-1
1712					40,2757	26161 0	DEGCON1	2DEC	5.555555555	B-3
1712					40,2760	30707 1				
1713					40,2761	21616 0	DEGCON2	2DEC	2.222222222	B-2
1713					40,2762	07071 0				
1714					40,2763	71527 1	NEG.2	OCT	-06250	
										= .197753906 I.E. THE BIAS SCALED
1715	REP	7	LAST	343	40,2764	0 7052 1	ARTIN1SP	TC	DMP	
1716	REP	14	LAST	342	40,2765	00123 1		ADRES	SPTMP1	
1717	REP	133	LAST	344	40,2766	58 156 0		XCH	MPAC	+2
1718	REP	134	LAST	344	40,2767	56 155 0		XCH	MPAC	+1
1719	REP	135	LAST	344	40,2770	58 154 1		XCH	MPAC	
1720					40,2771	0 0006 1		EXTEND		
1721	REP	2	LAST	343	40,2772	1 2774 0		BZF	BINROUND	
1722	REP	5	LAST	340	40,2773	0 4161 0		TC	ALMCYCLE	
1723	REP	2	LAST	343	40,2774	0 3066 1	BINROUND	TC	2ROUND	
1724	REP	2	LAST	343	40,2775	0 3077 1		TC	TESTORUP	
1725	REP	4	LAST	344	40,2776	0 2747 1		TC	ENDSCALE	
17251	REP	8	LAST	344	40,2777	0 7052 1	ARTIN1SP	TC	DMP	
17252	REP	15	LAST	344	40,3000	00123 1		ADRES	SPTMP1	
17253	REP	3	LAST	344	40,3001	0 2774 1		TC	BINROUND	
1726	REP	138	LAST	344	40,3002	10 154 0	OPTDEGIN	CCS	MPAC	
1727					40,3003	0 3007 0		TC	+4	
1728					40,3004	0 3007 0		TC	+3	
1729	REP	8	LAST	344	40,3005	0 4161 0		TC	ALMCYCLE	
1730	REP	7	LAST	344	40,3006	0 4161 0		TC	ALMCYCLE	
1731	REP	1			40,3007	3 2763 1	OPDEGIN2	CAP	NEG.2	
1732	REP	137	LAST	344	40,3010	26 154 0		ADS	MPAC	
1733	REP	9	LAST	344	40,3011	0 7052 1		TC	DMP	
1734	REP	1			40,3012	02761 0		ADRES	DEGCON2	
1735	REP	17	LAST	296	40,3013	3 4677 0		CAP	BIT12	
1736	REP	138	LAST	344	40,3014	6 0155 0		AD	MPAC	+1

IP OF FORCE SIGN TO 1

TOO LARGE A LOAD. ALARM AND RECYCLE.

RETURNS IF NO OF/UP
 SCALES MPAC, +1 BY SPTMP1, SPTMP2.
 ASSUMES POINT BETWEEN HI AND LO PARTS
 OF SPCON. SHIFTS RESULTS LEFT BY 14.
 (BY TAKING RESULTS FROM MPAC+1, MPAC+2)

OPTICS SCALING ROUTINE

REJECT - INPUT. ALARM AND RECYCLE.
 REJECT - INPUT. ALARM AND RECYCLE.
 RANGE IS 90 DEG
 SUBTRACT BIAS
 MULT BY 100 / 45 B-2
 ROUND AS IN DEGINSP



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 44 E0 S4

1737	REP	3	LAST	344	40,3015	0 3070 0	TC	2ROUND +2
1738	REP	1			40,3016	0 2725 0	TC	DEGINSF2
1739	REP	10	LAST	344	40,3017	0 7052 1	DPINSF	DMP
1740	REP	16	LAST	344	40,3020	00123 1	ADRES	SPTMP1
1741	REP	139	LAST	344	40,3021	56 156 0	XCH	MPAC +2
1742					40,3022	6 0000 1	DOUBLE	
1743	REP	140	LAST	345	40,3023	54 156 1	TS	MPAC +2
1744	REP	56	LAST	342	40,3024	3 4714 1	CAP	ZERO
1745	REP	141	LAST	345	40,3025	6 0155 0	AD	MPAC +1
1746	REP	4	LAST	345	40,3026	0 3070 0	TC	2ROUND +2
1747	REP	3	LAST	344	40,3027	0 3077 1	TC	TESTOFUP
1748	REP	12	LAST	342	40,3030	50 140 1	INDEX	MIXBR
1749					40,3031	0 3031 0	TC	+0
1750	REP	1			40,3032	0 3042 1	TC	DPINORM
1751	REP	27	LAST	342	40,3033	3 0117 0	CA	DECOUNT
1752	REP	27	LAST	341	40,3034	6 0145 1	AD	NOUNADD
1753	REP	81	LAST	341	40,3035	54 002 1	TS	0
1754	REP	142	LAST	345	40,3036	56 155 0	XCH	MPAC +1
1755	REP	82	LAST	345	40,3037	50 002 0	INDEX	0
1756					40,3040	54 001 1	TS	1
1757	REP	5	LAST	344	40,3041	0 2747 1	TC	ENDSCALE
1758	REP	57	LAST	345	40,3042	3 4714 1	DPINORM	CAP
1759	REP	1			40,3043	0 3034 0	TC	DPINCOM
1760	REP	11	LAST	345	40,3044	0 7052 1	DPINSF2	TC
1761	REP	17	LAST	345	40,3045	00123 1	ADRES	SPTMP1
1762	REP	14	LAST	337	40,3046	3 6211 0	CAP	SIX
1763	REP	2	LAST	331	40,3047	0 3056 1	TC	TLEFTIN
1764	REP	3	LAST	343	40,3050	0 3021 1	TC	DPINSF +2
1765	REP	12	LAST	345	40,3051	0 7052 1	DPINSF4	TC
1766	REP	18	LAST	345	40,3052	00123 1	ADRES	SPTMP1
1767	REP	19	LAST	339	40,3053	3 4711 1	CAP	TWO
1768	REP	3	LAST	345	40,3054	0 3056 1	TC	TLEFTIN
1769	REP	4	LAST	345	40,3055	0 3021 1	TC	DPINSF +2
1770	REP	83	LAST	345	40,3056	56 002 0	TLEFTIN	XCH
1771	REP	1			40,3057	54 124 1	TS	SPTMP2
1772	REP	84	LAST	345	40,3060	56 002 0	XCH	0
1773	REP	19	LAST	345	40,3061	54 123 0	LEFTINCOM	TS
1774	REP	6	LAST	343	40,3062	0 4420 0	TC	TPSL1
1775	REP	20	LAST	345	40,3063	10 123 0	CCS	SPTMP1
1776	REP	1			40,3064	0 3061 0	TC	LEFTINCOM
1777	REP	2	LAST	345	40,3065	0 0124 0	TC	SPTMP2

SCALES MPAC, MPAC +1 BY SPTMP1,
SPTMP2. STORES LOW PART OF RESULT
IN (E SUBK) +1 OR E+1

RETURNS IF NO OP/UP

MIXEDNOUN
MIXED
E SUBK
NORMAL
E

PLACE LOW PART IN
(E SUBK) +1 MIXED
E +1 NORMAL

ASSUMES POINT BETWEEN BITS 7-8 OF HIGH
PART OF SF CONST. DPINSF2 SHIFTS RESULTS
LEFT BY 7, ROUNDS MPAC+2 INTO MPAC+1
SHIFT LEFT 7.

ASSUMES POINT BETWEEN BITS 11-12 OF HIGH
PART OF SF CONST. DPINSF2 SHIFTS RESULTS
LEFT BY 3, ROUNDS MPAC+2 INTO MPAC+1.
SHIFT LEFT 3.

SHIFTS MPAC, +1, +2 LEFT N. SETS OVPIND
TO +1 FOR OF, -1 FOR UP.
CALL WITH N-1 IN A.
LOOP TIME .37 MSEC.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 45 E0 34

1776	REF 143	LAST 345	40,3066	56 155 0	2ROUND	XCH	MPAC	+1	
1779			40,3067	6 0000 1		DOUBLE			
1780	REF 144	LAST 346	40,3070	54 155 1		TS	MPAC	+1	
1781	REF 65	LAST 345	40,3071	0 0002 0		TC	0		IF MPAC+1 DOES NOT OF/UP
1782	REF 145	LAST 346	40,3072	6 0154 1		AD	MPAC		
1783	REF 146	LAST 346	40,3073	54 154 0		TS	MPAC		
1784	REF 66	LAST 346	40,3074	0 0002 0		TC	0		IF MPAC DOES NOT OF/UP
1785	REF 5	LAST 343	40,3075	54 162 0		TS	MPAC+6		
1786	REF 67	LAST 346	40,3076	0 0002 0	2RNDEND	TC	0		
1787	REF 6	LAST 346	40,3077	10 162 0	TESTORUP	CCS	MPAC+6		RETURNS IF NO OF/UP
1788	REF 6	LAST 344	40,3100	0 4161 0		TC	ALMCYCLE		OF ALARM AND RECYCLE.
1789	REF 68	LAST 346	40,3101	0 0002 0		TC	0		
1790	REF 9	LAST 346	40,3102	0 4161 0		TC	ALMCYCLE		UP ALARM AND RECYCLE.
1791	REF 1		42,3365			SETLOC	ENDSPIN	+1	
17915	REF 2	LAST 333 TO 336'	146	146*		COUNT	42/PIN		
1792	REF 1		42,3365	0 3506 1	HMSIN	TC	ALL3DEC		IF ALL 3 WORDS WERE NOT LOADED, ALARM.
1793	REF 13	LAST 345	42,3366	0 7052 1		TC	DMP		XREG, XREGLP (=HOURS) WERE ALREADY PUT
1794	REF 1		42,3367	0 3447 0		ADRES	WHOLECON		INTO MPAC, MPAC+1.
1795	REF 1		42,3370	0 3456 0		TC	RND/TST		ROUND OFF TO WHOLE HRS IN MPAC+1.
1796	REF 56	LAST 345	42,3371	3 4714 1		CAP	ZERO		ALARM IF MPAC NON ZERO (G/ 16363).
1797	REF 147	LAST 346	42,3372	54 156 1		TS	MPAC	+2	
1798	REF 1		42,3373	3 3451 1		CAP	HRCON		
1799	REF 146	LAST 346	42,3374	54 154 0		TS	MPAC		
1800	REF 2	LAST 346	42,3375	3 3452 1		CAP	HRCON	+1	
1801	REF 149	LAST 346	42,3376	56 155 0		XCH	MPAC	+1	
1802	REF 6	LAST 334	42,3377	0 7256 1		TC	SHORIMP		
1803	REF 1		42,3400	0 3467 1		TC	MPACTST		ALARM IF MPAC NON ZERO (G/ 745)
1804	REF 150	LAST 346	42,3401	52 156 1		DXCH	MPAC	+1	STORE HOURS CONTRIBUTION
1805	REF 1		42,3402	52 124 1		DXCH	HITEMIN		
1806	REF 3	LAST 336	42,3403	3 1004 1		CA	YREG		PUT YREG, YREGLP INTO MPAC, +1.
1807	REF 2	LAST 73	42,3404	23=007 1		LXCH	YREGLP		
1808	REF 151	LAST 346	42,3405	52 155 1		DXCH	MPAC		
1809	REF 14	LAST 346	42,3406	0 7052 1		TC	DMP		
1810	REF 2	LAST 346	42,3407	0 3447 0		ADRES	WHOLECON		
1811	REF 2	LAST 346	42,3410	0 3456 0		TC	RND/TST		ROUND OFF TO WHOLE MIN IN MPAC+1
1812	REF 1		42,3411	4 3454 0		CS	59MIN		ALARM IF MPAC NON ZERO (G/16363)
1813	REF 1		42,3412	0 3474 0		TC	SIZETST		ALARM IF MPAC+1 G/ 59MIN
1814	REF 152	LAST 346	42,3413	56 155 0		XCH	MPAC	+1	
1815			42,3414	0 0006 1		EXTEND			
1816	REF 1		42,3415	7 3453 1		MP	MINCON		LEAVES MINUTES CONTRIBUTION IN A,L
1817	REF 2	LAST 346	42,3416	20 124 1		DAS	HITEMIN		ADD IN MINUTES CONTRIBUTION
1818			42,3417	0 0006 1		EXTEND			IF THIS DAS OVERFLOWS, G/ 745HR, 39MIN
1819			42,3420	1 3422 1		BZF	+2		
1820	REF 10	LAST 346	42,3421	0 4161 0		TC	ALMCYCLE		



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 48

E0 S4

1821 REF 3 LAST 338 42,3422 3 1005 0
1822 REF 2 LAST 73 42,3423 23=010 1
1823 REF 153 LAST 346 42,3424 52 155 1
1824 REF 15 LAST 346 42,3425 0 7052 1
1825 REF 3 LAST 346 42,3428 03447 0
1826 REF 3 LAST 346 42,3427 0 3458 0
1827 REF 1 42,3430 4 3455 1
1828 REF 2 LAST 346 42,3431 0 3474 0
1829 REF 3 LAST 346 42,3432 52 124 1
1830 REF 154 LAST 347 42,3433 20 155 1
1831 42,3434 0 0006 1
1832 42,3435 1 3437 0
1833 REF 11 LAST 346 42,3436 0 4181 0
1834 REF 59 LAST 346 42,3437 3 4714 1
1835 REF 155 LAST 347 42,3440 54 156 1
1836 REF 6 LAST 336 42,3441 0 7228 0
1837 REF 156 LAST 347 42,3442 52 155 1
1838 REF 26 LAST 345 42,3443 50 145 1
1839 42,3444 52 001 1
1840 REF 24 LAST 344 42,3445 0 4574 0
1841 REF 10 LAST 342 42,3446 82771 1

CA ZREG
LXCH ZREGLP
DXCH MPAC
TC DMP
ADRES WHOLECON
TC RND/TST
CS 59.99SEC
TC SIZETST
DXCH HITEMIN
DAS MPAC
EXTEND
BZF +2
TC ALMCYCLE
CAP ZERO
TS MPAC +2
TC TPAGREE
DXCH MPAC
INDEX NOUNADD
DXCH 0
TC POSTJUMP
CADR LOADLV

PUT ZREG, ZREGLP INTO MPAC, +1.

ROUND OFF TO WHOLE CENTI-SEC IN MPAC+1
ALARM IF MPAC NON ZERO (G/163.83 SEC)
ALARM IF MPAC+1 G/59.99 SEC
ADD IN SECONDS CONTRIBUTION
IF THIS DAS OVERFLOWS,
G/ 745 HR, 39 MIN, 14.55 SEC.

ALARM AND RECYCLE

1842 42,3447 00006 1 WHOLECON OCT 00006
1843 42,3450 03240 1 OCT 03240
1844 42,3451 00025 0 HRCON OCT 00025
1845 42,3452 37100 1 OCT 37100
1846 42,3453 13580 0 MINCON OCT 13580
1847 42,3454 00073 0 59MIN OCT 00073
1848 42,3455 13557 1 59.99SEC OCT 13557
1849 REF 157 LAST 347 42,3458 58 158 0 RND/TST XCH MPAC +2
1850 42,3457 6 0000 1 DOUBLE
1851 REF 156 LAST 347 42,3460 54 156 1 TS MPAC +2
1852 REF 60 LAST 347 42,3461 3 4714 1 CAP ZERO
1853 REF 159 LAST 347 42,3462 8 0155 0 AD MPAC +1
1854 REF 160 LAST 347 42,3463 54 155 1 TS MPAC +1
1855 REF 61 LAST 347 42,3464 3 4714 1 CAP ZERO
1856 REF 161 LAST 347 42,3465 6 0154 1 AD MPAC
1857 REF 162 LAST 347 42,3466 58 154 1 XCH MPAC
1858 REF 163 LAST 347 42,3467 10 154 0 MPACTST CCS MPAC
1859 REF 12 LAST 347 42,3470 0 4181 0 TC ALMCYCLE
1860 REF 89 LAST 346 42,3471 0 0002 0 TC 0
1861 REF 13 LAST 347 42,3472 0 4181 0 TC ALMCYCLE
1862 REF 90 LAST 347 42,3473 0 0002 0 TC 0

(10EXP5/2EXP14)2EXP14

1 HOUR IN CENTI-SEC

1 MINUTE IN CENTI-SEC

59 AS WHOLE

5999 CENTI-SEC

ROUNDS MPAC+2 INTO MPAC+1.

ALARMS IF MPAC NOT 0

CANT OVFLOW

ALARM IF MPAC NON ZERO

ALARM AND RECYCLE.

ALARM AND RECYCLE.

1863 REF 164 LAST 347 42,3474 54 156 1 SIZETST TS MPAC +2
1864 REF 165 LAST 347 42,3475 10 155 1 CCS MPAC +1
1865 REF 35 LAST 342 42,3478 8 4712 1 AD ONE
1866 42,3477 1 3501 1 TCP +2

CALLED WITH - CON IN A
GET MAG OF MPAC+1



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28,1988 KOOLADE .089 PAGE 348

L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 47 E0 34

1887	REF 36	LAST 347	42,3500	8 4712 1	AD	ONE
1888	REF 188	LAST 347	42,3501	8 0158 0	AD	MPAC +2
1889			42,3502	0 0008 1	EXTEND	
1870			42,3503	8 3505 1	BZMP	+2
1871	REF 14	LAST 347	42,3504	0 4181 0	TC	ALMCYCLE
1872	REF 91	LAST 347	42,3505	0 0002 0	TC	0
R1873	ALL3DEC TESTS THAT ALL 3 WORDS ARE LOADED IN DEC (FOR RMSIN).					
R1874	ALARM IF NOT. (TEST THAT BITS 3,4,5 OF DECBRNCH ARE ALL = 1)					
1875	REF 1		42,3508	4 3513 1	ALL3DEC	CS OCT34BAR
1878	REF 17	LAST 341	42,3507	7 1000 1	MASK	DECBRNCH
1877	REF 2	LAST 348	42,3510	8 3513 0	AD	OCT34BAR
1878	REF 108	LAST 344	42,3511	10 000 0	CCS	A
1879	REF 1		42,3512	0 3518 0	TC	FORCEV25
1880			42,3513	77743 1	OCT34BAR	OCT 77743
1881	REF 2	LAST 348	42,3514	0 3518 0	TC	FORCEV25
1882	REF 92	LAST 348	42,3515	0 0002 0	TC	0
18825	REF 1		42,3518	4 4113 1	FORCEV25	CS OCT31
18826	REF 2	LAST 319	42,3517	55=041 1	TS	VERBSAVE
18827	REF 15	LAST 348	42,3520	0 4181 0	TC	ALMCYCLE
1883			42,3521		ENDHMS	EQUALS

MAG OF MPAC+1 - CON

MAG OF MPAC+1 G/ CON. ALARM AND RECYCLE.
MAG OF MPAC+1 L/= CON

GET BITS 3,4,5 IN A
GET BITS 3,4,5 OF DECBRNCH IN A
BITS 3,4,5 OF DECBRNCH MUST ALL = 1

FORCE VERB 25 TO BE EXECUTED BY RECYCLE
IN CASE OPERATOR EXECUTED A LOWER LOAD
VERB. ALARM AND RECYCLE.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 48 EO 54

R1884 MONITOR ALLOWS OTHER KEYBOARDED ACTIVITY. IT IS ENDED BY VERB TERMINATE,
R1885 VERB PROCEED WITHOUT DATA, VERB RESEQUENCE,
R1886 ANOTHER MONITOR, OR ANY NVSUB CALL THAT PASSES THE DSPLOCK (PROVIDED
R18881 THAT THE OPERATOR HAS ~~SEEN~~ ALLOWED THE ENDING OF A MONITOR WHICH
R18882 HE HAS INITIATED THROUGH THE KEYBOARD).

R1887 MONITOR ACTION IS SUSPENDED, BUT NOT ENDED, BY ANY KEYBOARD ACTION,
R1888 EXCEPT ERROR LIGHT RESET. IT BEGINS AGAIN WHEN KEY RELEASE IS PERFORMED.
R1889 MONITOR SAVES THE NOUN AND APPROPRIATE DISPLAY VERB IN MONSAVE. IT SAVES
R1890 NOUNCADR IN MONSAVE1, IF KOLN = MACHINE CADR TO BE SPECIFIED. BIT 15 OF
R1891 MONSAVE1 IS THE KILL MONITOR SIGNAL (KILLER BIT). BIT 14 OF MONSAVE1
R18911 INDICATES THE CURRENT MONITOR WAS EXTERNALLY INITIATED (EXTERNAL
R18912 MONITOR BIT). IT IS TURNED OFF BY RELDSP AND KILMONCN.

R1892 MONSAVE INDICATES IF MONITOR IS ON(+=ON, +0=OFF)
R1893 IF MONSAVE IS +, MONITOR ENTERS NO REQUEST, BUT TURNS KILLER BIT OFF.
R1894 IF MONSAVE IS +0, MONITOR ENTERS REQUEST AND TURNS KILLER BIT OFF.

R1895 NVSUB (IF EXTERNAL MONITOR BIT IS OFF), VB=PROCEED WITHOUT DATA,
R1898 VB=RESEQUENCE, AND VB=TERMINATE TURN KILL MONITOR BIT ON.

R1897 IF KILLER BIT IS ON, MONITOR ENTERS NO FURTHER REQUESTS, ZEROS MONSAVE
R1898 AND MONSAVE1 (TURNING OFF KILLER BIT AND EXTERNAL MONITOR BIT).

R1899 MONITOR DOESNT TEST FOR MATBS SINCE NVSUB CAN HANDLE INTERNAL MATBS NOW
1900 REF 1 41,3220 SETLOC ENDRUTIN

19005 REF 3 LAST 337 TO 343* 262 656* COUNT 41/PIN

1901	REF	1		41,3220	4 3227 1	MONITOR	CS	BIT15/14	
1902	REF	6	LAST 342	41,3221	7 1017 1		MASK	NOUNCADR	
1903	REF	167	LAST 348	41,3222	54 155 1	MONIT1	TS	MPAC +1	TEMP STORAGE
19031	REF	7	LAST 336	41,3223	4 0136 1		CS	ENTEXIT	
19032	REF	4	LAST 319	41,3224	6 4233 1		AD	ENDINST	
19033	REF	107	LAST 348	41,3225	10 000 0		CCS	A	
19034	REF	1		41,3226	0 3235 0		TC	MONIT2	
19035				41,3227	60000 1	BIT15/14	OCT	60000	
19036	REF	2	LAST 349	41,3230	0 3235 0		TC	MONIT2	
19037	REF	27	LAST 327	41,3231	3 4675 1		CAF	BIT14	EXTERNALLY INITIATED MONITOR, SET BIT 14 FOR MONSAVE1.
19038	REF	186	LAST 349	41,3232	26 155 1		ADS	MPAC +1	
190361	REF	62	LAST 347	41,3233	3 4714 1		CAF	ZERO	
190382	REF	1		41,3234	55*022 1		TS	MONSAVE2	ZERO NVMONOPT OPTIONS
1904	REF	3	LAST 198	41,3235	3 8043 0	MONIT2	CAF	LOW7	
1905	REF	17	LAST 328	41,3236	7 1001 0		MASK	VERBREG	
1906	REF	4	LAST 341	41,3237	0 4345 1		TC	LEPT5	
1907	REF	5	LAST 312	41,3240	54 022 0		TS	CYL	
1908	REF	6	LAST 349	41,3241	4 0022 0		CS	CYL	
1909	REF	7	LAST 349	41,3242	58 022 1		XCH	CYL	
1910	REF	11	LAST 337	41,3243	6 1002 1		AD	NOUNREG	
1911	REF	189	LAST 349	41,3244	54 154 0		TS	MPAC	TEMP STORAGE

L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 49 E0 S4

1912 REF 63 LAST 349 41,3245 3 4714 1
 1913 REF 3 LAST 310 41,3246 55=012 1
 1914 REF 4 LAST 319 41,3247 11=042 1
 1915 REF 1 41,3250 0 3252 1
 1916 REF 1 41,3251 0 4516 1
 1917 REF 1 41,3252 0 0004 0
 1918 REF 2 LAST 188 41,3253 11=020 0
 1919 REF 1 41,3254 0 3261 1
 1920 REF 37 LAST 348 41,3255 3 4712 1
 1921 REF 11 LAST 243 41,3256 0 5140 1
 1922 REF 39 LAST 342 0777
 1923 REF 1 41,3257 03265 0
 1923 REF 1 41,3260 62101 0
 1924 REF 170 LAST 349 41,3261 52 155 1
 1925 REF 3 LAST 350 41,3262 53=021 1
 1926 REF 1 41,3263 0 0003 1
 1927 REF 4 LAST 318 41,3264 0 0136 0
 1928 REF 1 41,3265 0 4414 1 MONREQ
 1929 REF 2 LAST 188 41,3266 11=021 1
 1930 REF 1 41,3267 0 3273 1
 1931 REF 1 41,3270 0 3273 1
 1932 REF 1 41,3271 0 3304 0
 1933 REF 2 LAST 350 41,3272 0 3304 0
 1934 REF 1 41,3273 3 3310 0
 1935 REF 12 LAST 350 41,3274 0 5140 1
 1936 REF 40 LAST 350 0777
 1937 REF 2 LAST 350 41,3275 03265 0
 1937 REF 1 41,3276 62101 0
 1938 REF 2 LAST 132 41,3277 3 4371 0
 1939 REF 11 LAST 298 41,3300 0 5027 1
 1940 REF 41 LAST 350 0777
 1941 REF 1 41,3301 03311 1
 1941 REF 1 41,3302 62101 0
 1942 REF 12 LAST 244 41,3303 0 5213 1
 1943 REF 64 LAST 350 41,3304 3 4714 1 KILLMON
 1944 REF 4 LAST 350 41,3305 55=020 0
 1945 REF 3 LAST 350 41,3306 55=021 1
 1946 REF 13 LAST 350 41,3307 0 5213 1
 1947 REF 1 41,3310 00144 0 MONDEL
 1948 REF 4 LAST 350 41,3311 11=021 1 MONDO
 1949 REF 1 41,3312 0 3316 0
 1950 REF 1 41,3313 0 3316 0
 1951 REF 32 LAST 316 41,3314 0 5112 0
 1952 REF 33 LAST 350 41,3315 0 5112 0
 1953 REF 4 LAST 350 41,3316 11=012 1

CAP ZERO
 TS DSPLOCK
 CCS CADRSTOR
 TC +2
 TC RELDSP1
 INHINT
 CCS MONSAVE
 TC +5
 CAP ONE
 TC WAITLIST
 EBANK= DSPCOUNT
 2CADR MONREQ
 DXCH MPAC
 DXCH MONSAVE
 RELINT
 TC ENTRET
 TC LODSAMP
 CCS MONSAVE1
 TC +4
 TC +3
 TC KILLMON
 TC KILLMON
 CAP MONDEL
 TC WAITLIST
 EBANK= DSPCOUNT
 2CADR MONREQ
 CAP CHRPRIO
 TC NOVAC
 EBANK= DSPCOUNT
 2CADR MONDO
 TC TASKOVER
 CAP ZERO
 TS MONSAVE
 TS MONSAVE1
 TC TASKOVER
 OCT 144
 CCS MONSAVE1
 TC +4
 TC +3
 TC ENDOPJOB
 TC ENDOPJOB
 CCS DSPLOCK

+0 INTO DSPLOCK SO MONITOR CAN RUN.
 TURN OFF KR LITE IF CADRSTOR AND DSPLIST
 ARE BOTH EMPTY. (LITE COMES ON IF NEW
 MONITOR IS KEYED IN OVER OLD MONITOR.)

IF MONSAVE WAS +, NO REQUEST
 IF MONSAVE WAS 0, REQUEST MONREQ

PLACE MONITOR VERB AND NOUN INTO MONSAVE
 ZERO THE KILL MONITOR BIT
 SET UP EXTERNAL MONITOR BIT

CALLED BY WAITLIST
 TIME IS SNATCHED IN RUPT FOR NOUN 65
 IF KILLER BIT = 0, ENTER REQUESTS
 IF KILLER BIT = 0, ENTER REQUESTS
 IF KILLER BIT = 1, NO REQUESTS
 IF KILLER BIT = 1, NO REQUESTS

ENTER WAITLIST REQUEST FOR MONREQ

ENTER EXEC REQUEST FOR MONDO

ZERO MONSAVE AND TURN KILLER BIT OFF

TURN OFF KILL MONITOR BIT.
 TURN OFF EXTERNAL MONITOR BIT.
 FOR 1 SEC MONITOR INTERVALS
 CALLED BY EXEC
 IF KILLER BIT = 0, CONTINUE
 IF KILLER BIT = 0, CONTINUE
 IN CASE TERMINATE CAME SINCE LAST MONREQ
 IN CASE TERMINATE CAME SINCE LAST MONREQ



L PINBALL GAME' BUTTONS AND LIGHTS

USER'S PAGE NO. 50 EQ S4

1954	REF	1		41,3317	0 3341 1	TC	MONBUSY	NVSUB IS BUSY
1955	REF	4	LAST 349	41,3320	3 8043 0	CAP	LOW7	
1956	REF	5	LAST 350	41,3321	7 1020 0	MASK	MONSAVE	
1958	REF	1		41,3322	0 2318 1	TC	UPDATNN -1	PLACE NOUN INTO NOUNREG AND DISPLAY IT
1960	REF	1		41,3323	3 4180 1	CAP	MID7	
1961	REF	6	LAST 351	41,3324	7 1020 0	MASK	MONSAVE	CHANGE MONITOR VERB TO DISPLAY VERB
1962	REF	1		41,3325	8 3337 0	AD	MONREF	-DEC10, STARTING IN BITS
1963	REF	1		41,3326	54 023 1	TS	EDOP	RIGHT 7
1964	REF	2	LAST 351	41,3327	3 0023 0	CA	EDOP	
1965	REF	18	LAST 349	41,3330	55*001 0	TS	VERBREG	
1966	REF	1		41,3331	3 3340 0	CAP	MONBACK	SET RETURN TO PASTEVB AFTER DATA DISPLAY
1967	REF	5	LAST 350	41,3332	54 136 1	TS	ENTRET	
1968	REF	2	LAST 349	41,3333	4 3227 1	CS	BIT15/14	
1969	REF	5	LAST 350	41,3334	7 1021 1	MASK	MONSAVE1	PUT ECADR INTO MPAC +2. INTMCTBS WILL
1970	REF	171	LAST 350	41,3335	54 158 1	TS	MPAC +2	DISPLAY IT AND SET NOUNCADR, NOUNADD,
1971	REF	1		41,3336	0 2048 1	ENDMONDO TC	TESTNN	EBANK.
1972				4140		BLOCK 2		
197201	REF	1		4000		SETLOC	PFTAG8	
197202				4140		BANK		
19725	REF.	1				COUNT	02/PIN	
1973	REF	2	LAST 351	4140	3 4180 1	PASTEVB CAP	MID7	
1974	REF	2	LAST 349	4141	7 1022 1	MASK	MONSAVE2	NVMONOPT PASTE OPTION
1975				4142	0 0008 1	EXTEND		
1976				4143	1 4145 1	BZF	+2	
1977	REF	1		4144	0 4146 0	TC	PASTEOPT	PASTE PLEASE VERB FOR NVMONOPT
1978	REF	7	LAST 351	4145	3 1020 1	CA	MONSAVE	PASTE MONITOR VERB - PASTE OPTION IS 0
19782	REF	3	LAST 351	4146	54 023 1	PASTEOPT TS	EDOP	RIGHT 7
19783	REF	4	LAST 351	4147	3 0023 0	CA	EDOP	PLACE MONITOR VERB OR PLEASE VERB INTO
197832	REF	49	LAST 335	4150	0 4555 0	TC	BANKCALL	VERBREG AND DISPLAY IT.
197833	REF	7	LAST 338	4151	82338 0	CADR	UPDATVB -1	
197835	REF	65	LAST 350	4152	3 4714 1	CAP	ZERO	ZERO REREOT SO THAT PASTED VERBS CAN
197838	REF	10	LAST 323	4153	55*013 0	TS	REREOT	BE EXECUTED BY OPERATOR.
19784	REF	3	LAST 351	4154	3 1022 0	CA	MONSAVE2	
19785	REF	1		4155	0 4271 1	TC	BLANKSUB	PROCESS NVMONOPT.BLANK OPTION IF ANY
19786				4156	0 4157 0	TC	+1	
19787	REF	34	LAST 350	4157	0 5112 0	ENDPASTE TC	ENDOFJOB	
1979				4160	37800 0	MID7	OCT 37800	
1980	REF	1		41,3337		SETLOC	ENDMONDO +1	
19805	REF	4	LAST 349 TO 351'	79 735*		COUNT	41/PIN	
1981				41,3337	75377 0	MONREF	OCT 75377	-DEC10, STARTING IN BITS
1982	REF	1		41,3340	04140 0	MONBACK	ADRES PASTEVB	



L PINEBALL GAME BUTTONS AND LIGHTS

USER=8 PAGE NO. 51 E0 84

1983 REP 2 LAST 310 41,3341 0 4410 0 MONBUSY TC RELDSPON
 1984 REP 35 LAST 351 41,3342 0 5112 0 TC ENDOPJOB
 R1985 DSPFMEM IS USED TO DISPLAY (IN OCTAL) ANY FIXED REGISTER.
 R1986 IT IS USED WITH NOUN = MACHINE CADR TO BE SPECIFIED. THE FCADR OF THE
 R1987 DESIRED LOCATION IS THEN PUNCHED IN. IT HANDLES P/P (FCADR 4000-7777)

TURN KEY RELEASE LIGHT

R19871 FOR BANKS L/E 27, THIS IS ENOUGH.

R19872 FOR BANKS G/E 30, THE THIRD COMPONENT OF NOUN 26 (PRIO, ADRES, BBCON)
 R19873 MUST BE PRELOADED WITH THE DESIRED SUPERBANK BITS (BITS 5,6,7).
 R19874 V23N26 SHOULD BE USED.

R19875 SUMMARY

R19876 FOR BANKS L/E 27,

R19877 FOR BANKS G/E 30, V23N26E(SUPERBITS)E V27N01E(PCADR)E
 V27N01E(PCADR)E

1988	REP	12	LAST	336	41,3343	3	4333	0	DSPFMEM	CAP	R1D1
1989	REP	42	LAST	350	41,3344	54	777	1	TS	DSPCOUNT	
19891	REP	15	LAST	277	41,3345	3	1047	0	CA	DSPTEM1 +2	
19892	REP	40	LAST	340	41,3346	54	001	1	TS	L	
1990	REP	7	LAST	349	41,3347	3	1017	0	CA	NOUNCADR	
1991	REP	1			41,3350	0	4810	1	TC	SUPDICAL	
1992	REP	3	LAST	326	41,3351	0	3353	1	TC	DSPCTWD	
1993	REP	36	LAST	352	41,3352	0	5112	0	ENDSPF	TC	ENDOPJOB

IF P/P, DATACALL USES BANK 02 OR 03.

SUPERBANK BITS WERE PRELOADED INTO
 3RD COMPONENT OF NOUN 26.
 ORIGINAL FCADR LOADED STILL IN NOUNCADR.
 CALL WITH FCADR IN A, SUPERBITS IN L.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 52 E0 84

P1994 WORD DISPLAY ROUTINES

1995	REF	4	LAST	345	40,3103		SETLOC	TESTOPUF	+4
19955	REF	5	LAST	343 TO	346'	119 579*	COUNT	40/PIN	
1996	REF	93	LAST	348	40,3103	58 002 0	DSPSIGN	XCH	0
1997	REF	1			40,3104	54 144 1	TS	DSPWDRET	
1998	REF	172	LAST	351	40,3105	10 154 0	CCS	MPAC	
1999					40,3106	0 3116 1	TC	+8D	
2000					40,3107	0 3116 1	TC	+7	
2001	REF	38	LAST	350	40,3110	6 4712 1	AD	ONE	
2002	REF	173	LAST	353	40,3111	54 154 0	TS	MPAC	
2003	REF	2	LAST	314	40,3112	0 2334 1	TC	-QN	
2004	REF	174	LAST	353	40,3113	4 0155 1	CS	MPAC +1	
2005	REF	175	LAST	353	40,3114	54 155 1	TS	MPAC +1	
2006	REF	2	LAST	353	40,3115	0 0144 0	TC	DSPWDRET	
2007	REF	3	LAST	332	40,3116	0 2314 0	TC	+QN	
2008	REF	3	LAST	353	40,3117	0 0144 0	TC	DSPWDRET	

2009					40,3120	0 0006 1	DSPRND	EXTEND	
2010	REF	1			40,3121	3 3164 1	DCA	DECRND -1	
2011	REF	176	LAST	353	40,3122	20 155 1	DAS	MPAC	
2012					40,3123	0 0006 1	EXTEND		
2013					40,3124	1 3130 1	BZF	+4	
2014					40,3125	0 0006 1	EXTEND		
2015	REF	1			40,3126	3 4672 0	DCA	DPOSMAX	
2016	REF	177	LAST	353	40,3127	52 155 1	DXCH	MPAC	
2017	REF	94	LAST	353	40,3130	0 0002 0	TC	0	

ROUND BY 5 EXP-6

R2018 DSPDECWD CONVERTS C(MPAC, MPAC+1) INTO A SIGN AND 5 CHAR DECIMAL
R2019 STARTING IN LOC SPECIFIED IN DSPCQNT. IT ROUNDS BY 5 EXP-6.

2020	REF	95	LAST	353	40,3131	58 002 0	DSPDECWD	XCH	0
2021	REF	1			40,3132	54 115 0	TS	WDRET	
2022	REF	1			40,3133	0 3103 0	TC	DSPSIGN	
2023	REF	1			40,3134	0 3120 1	TC	DSPRND	
2024	REF	4	LAST	298	40,3135	3 4710 0	CAP	FOUR	
2025	REF	1			40,3136	54 137 0	DSPDCWD1	TS	WDCNT
2026	REF	1			40,3137	3 4377 0	CAP	BINCON	
2027	REF	7	LAST	346	40,3140	0 7256 1	TC	SHORTMP	
2028	REF	178	LAST	353	40,3141	50 154 1	TRACE1	INDEX	MPAC
2029	REF	3	LAST	311	40,3142	3 4072 0	CAP	RELTAB	
2030	REF	6	LAST	341	40,3143	7 4362 0	MASK	LOW5	
2031	REF	6	LAST	334	40,3144	54 124 1	TS	CODE	
2032	REF	66	LAST	351	40,3145	3 4714 1	CAP	ZERO	
2033	REF	179	LAST	353	40,3146	56 156 0	XCH	MPAC +2	
2034	REF	180	LAST	353	40,3147	56 155 0	XCH	MPAC +1	
2035	REF	181	LAST	353	40,3150	54 154 0	TS	MPAC	
2036	REF	43	LAST	352	40,3151	56 777 0	XCH	DSPCQNT	
2037	REF	4	LAST	334	40,3152	54 143 0	TRACR1S	TS	COUNT

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 53 E0 S4

2038	REP	108	LAST	349	40,3153	10 000 0	CCS	A	
2039	REP	44	LAST	353	40,3154	54 777 1	TS	DSPCOUNT	
2040	REP	4	LAST	335	40,3155	0 3225 1	TC	DSPIN	
2041	REP	2	LAST	353	40,3156	10 137 0	CCS	WDCNT	
2042	REP	1			40,3157	0 3136 0	TC	DSPDCWD1	
2043	REP	7	LAST	339	40,3160	4 4374 1	CS	VD1	
2044	REP	45	LAST	354	40,3161	54 777 1	TS	DSPCOUNT	
2045	REP	2	LAST	353	40,3162	0 0115 1	TC	WORET	

DECREMENT DSPCOUNT EXCEPT AT +0

2046					40,3163	00000 1	OCT	00000	
2047					40,3164	02476 0	DEGROUND OCT	02476	

R2046 DSPDECNR CONVERTS C(MPAC,MPAC+1) INTO A SIGN AND 5 CHAR DECIMAL
R2049 STARTING IN LOC SPECIFIED IN DSPCOUNT. IT DOES NOT ROUND

2050	REP	96	LAST	353	40,3165	56 002 0	DSPDECNR XCH	0	
2051	REP	3	LAST	354	40,3166	54 115 0	TS	WORET	
2052	REP	2	LAST	353	40,3167	0 3103 0	TC	DSPSIGN	
2053	REP	2	LAST	354	40,3170	0 3135 0	TC	DSPDCWD1 -1	

R2054 DSPDC2NR CONVERTS C(MPAC,MPAC+1) INTO A SIGN AND 2 CHAR DECIMAL
R2055 STARTING IN LOC SPECIFIED IN DSPCOUNT. IT DOES NOT ROUND

2056	REP	97	LAST	354	40,3171	56 002 0	DSPDC2NR XCH	0	
2057	REP	4	LAST	354	40,3172	54 115 0	TS	WORET	
2058	REP	3	LAST	354	40,3173	0 3103 0	TC	DSPSIGN	
2059	REP	39	LAST	353	40,3174	3 4712 1	CAF	ONE	
2060	REP	3	LAST	354	40,3175	0 3136 0	TC	DSPDCWD1	

R2061 DSP2DEC CONVERTS C(MPAC) AND C(MPAC+1) INTO A SIGN AND 10 CHAR DECIMAL
R2062 STARTING IN THE LOC SPECIFIED IN DSPCOUNT.

2063	REP	96	LAST	354	40,3176	56 002 0	DSP2DEC XCH	0	
2064	REP	5	LAST	354	40,3177	54 115 0	TS	WORET	
2065	REP	67	LAST	353	40,3200	3 4714 1	CAF	ZERO	
2066	REP	7	LAST	353	40,3201	54 124 1	TS	CODE	
2067	REP	12	LAST	334	40,3202	3 6214 0	CAF	THREE	
2068	REP	3	LAST	315	40,3203	0 3307 0	TC	11DSPIN	-R2 OFF
2069	REP	5	LAST	353	40,3204	3 4710 0	CAF	FOUR	
2070	REP	4	LAST	354	40,3205	0 3307 0	TC	11DSPIN	+R2 OFF
2071	REP	4	LAST	354	40,3206	0 3103 0	TC	DSPSIGN	
2072	REP	4	LAST	333	40,3207	3 4334 1	CAF	R2D1	
2073	REP	4	LAST	354	40,3210	0 3136 0	END2DEC TC	DSPDCWD1	

R2074 DSPDECVN DISPLAYS C(A) UPON ENTRY AS A 2 CHAR DECIMAL BEGINNING IN THE
R2075 DSP LOC SPECIFIED IN DSPCOUNT.
R2076 C(A) SHOULD BE IN FORM N X 2EXP-14. THIS IS SCALED TO FORM N/100 BEFORE
R2077 DISPLAY CONVERSION.

L PINBALL GAME BUTTONS AND LIGHTS

USERS PAGE NO. 54 E0 84

2078 40,3211 0 0008 1 DSPDCVN EXTEND
 2079 REF 1 40,3212 7 3221 1 MP VNDSPCN
 2080 REF 162 LAST 353 40,3213 22 154 1 LXCH MPAC
 2081 REF 68 LAST 354 40,3214 3 4714 1 CAP ZERO
 2082 REF 183 LAST 355 40,3215 54 155 1 TS MPAC +1
 2083 REF 99 LAST 354 40,3218 56 002 0 XCH Q
 2084 REF 6 LAST 354 40,3217 54 115 0 TS WORET
 2085 REF 3 LAST 335 40,3220 0 3174 0 TC DSPDC2NR +3

 2086 40,3221 00244 0 VNDSPCN OCT 00244
 2087 REF 3 LAST 332 40,3222 0 3211 0 GOVNUPTD TC DSPDCVN
 2088 REF 25 LAST 347 40,3223 0 4574 0 TC POSTJUMP
 2089 REF 2 LAST 323 40,3224 62346 1 CADR UPDAT1 +2

 2090 40,3225 ENDECVN EQUALS
 2091 REF 1 41,3353 SETLOC ENDSPP +1
 20915 REF 5 LAST 351 TO 353' 12 747* COUNT 41/PIN

MULT BY .01
 TAKE RESULTS FROM L.(MULT BY 2EXP14).

 NO SIGN, NO ROUND, 2 CHAR

 .01 ROUNDED UP
 THIS IS NOT FOR GENERAL USE. REALLY PART
 OF UPDATVB.

R2092 DSPCOTWO DISPLAYS C(A) UPON ENTRY AS A 5 CHAR OCT STARTING IN THE DSP
 R2093 CHAR SPECIFIED IN DSPCOUNT. IT STOPS AFTER 5 CHAR HAVE BEEN DISPLAYED.

2094 REF 6 LAST 349 41,3353 54 022 0 DSPCOTWO TS CYL
 2095 REF 100 LAST 355 41,3354 58 002 0 XCH Q
 2096 REF 7 LAST 355 41,3355 54 115 0 TS WORET
 2097 REF 28 LAST 349 41,3356 3 4675 1 CAP BIT14
 2098 REF 46 LAST 354 41,3357 26 777 1 ADS DSPCOUNT
 2099 REF 8 LAST 354 41,3360 3 4710 0 CAP FOUR
 2100 REF 3 LAST 354 41,3381 54 137 0 WDAGAIN TS WDCNT
 2101 REF 9 LAST 355 41,3382 4 0022 0 CS CYL
 2102 REF 10 LAST 355 41,3383 4 0022 0 CS CYL
 2103 REF 11 LAST 355 41,3364 4 0022 0 CS CYL
 2104 REF 109 LAST 354 41,3385 4 0000 0 CS A
 2105 REF 1 41,3366 7 4716 1 MASK DSPMSK
 2106 REF 110 LAST 355 41,3367 50 000 1 INDEX A
 2107 REF 4 LAST 353 41,3370 3 4072 0 CAP RELTAB
 2108 REF 7 LAST 353 41,3371 7 4362 0 MASK LOWS
 2109 REF 8 LAST 354 41,3372 54 124 1 TS CODE
 2110 REF 47 LAST 355 41,3373 58 777 0 XCH DSPCOUNT
 2111 REF 5 LAST 353 41,3374 54 143 0 TS COUNT
 2112 REF 111 LAST 355 41,3375 10 000 0 CCS A
 2113 REF 46 LAST 355 41,3376 54 777 1 TS DSPCOUNT
 2114 REF 26 LAST 355 41,3377 0 4574 0 TC POSTJUMP
 2115 REF 1 41,3400 81315 1 CADR DSPCOTIN
 2116 REF 4 LAST 355 41,3401 10 137 0 OCTBACK CCS WDCNT
 2117 REF 1 41,3402 0 3381 0 TC WDAGAIN
 2118 REF 8 LAST 354 41,3403 4 4374 1 DSPLV CS VD1

MUST USE SAME RETURN AS DSP2BIT.
 TO BLANK SIGNS

DECREMENT DSPCOUNT EXCEPT AT +0

*
 TO BLOCK NUMERICAL CHARACTERS, CLEARS,

L PINEBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 55 E0 54

2119 REF 49 LAST 355 41,3404 54 777 1 TS DSPCOUNT
2120 REF 8 LAST 355 41,3405 0 0115 1 TC WDRET
2121 REF 7 LAST 342 4716 DSPMSK = SEVEN
R2122 DSP2BIT DISPLAYS C(A) UPON ENTRY AS A 2 CHAR OCT BEGINNING IN THE DSP
R2123 LOC SPECIFIED IN DSPCOUNT BY PRE CYCLING RIGHT C(A) AND USING THE LOGIC
R2124 OF THE 5 CHAR OCTAL DISPLAY

AND SIGNS AFTER A COMPLETED DISPLAY.

2125 REF 3 LAST 198 41,3406 54 020 1 DSP2BIT TS CYR
2126 REF 101 LAST 355 41,3407 56 002 0 XCH 0
2127 REF 9 LAST 356 41,3410 54 115 0 TS WDRET
2128 REF 40 LAST 354 41,3411 3 4712 1 CAP ONE
2129 REF 5 LAST 355 41,3412 54 137 0 TS WDCNT
2130 REF 4 LAST 356 41,3413 4 0020 1 CS CYR
2131 REF 5 LAST 356 41,3414 4 0020 1 CS CYR
2132 REF 6 LAST 356 41,3415 56 020 0 XCH CYR
2133 REF 12 LAST 355 41,3416 54 022 0 TS CYL
2134 REF 2 LAST 355 41,3417 0 3366 1 TC WDAGAIN +5
R2135 FOR DSPIN PLACE 0/25 OCT INTO COUNT, 5 BIT RELAY CODE INTO CODE, BOTH
R2136 ARE DESTROYED. IF BIT14 OF COUNT IS 1, SIGN IS BLANKED WITH LEFT CHAR.
R2137 FOR DSPIN1 PLACE 0,1 INTO BIT11 OF CODE, 2 INTO COUNT, REL ADDRESS OF
R2138 DSPTAB ENTRY INTO DSREL.

2139 REF 1 40,3225 SETLOC ENDECVN

21395 REF 6 LAST 353 TO 355' 82 661* COUNT 40/PIN

2140 REF 102 LAST 356 40,3225 56 002 0 DSPIN XCH 0
2141 REF 1 40,3226 54 114 1 TS DSEXIT
2142 REF 8 LAST 355 40,3227 3 4362 1 CAP LOWS
2143 REF 6 LAST 355 40,3230 7 0143 0 MASK COUNT
2144 REF 9 LAST 340 40,3231 54 021 0 TS SR
2145 REF 10 LAST 356 40,3232 56 021 1 XCH SR
2146 REF 1 40,3233 54 141 1 TS DSREL
2147 REF 26 LAST 292 40,3234 3 4712 1 CAP BIT1
2148 REF 7 LAST 356 40,3235 7 0143 0 MASK COUNT
2149 REF 112 LAST 355 40,3236 10 000 0 CCS A
2150 40,3237 0 3241 0 TC +2
2151 REF 1 40,3240 0 3251 1 TC DSPIN1 -1
2152 REF 9 LAST 355 40,3241 56 124 0 XCH CODE
2153 REF 1 40,3242 0 4354 1 TC SLEPTS
2154 REF 10 LAST 356 40,3243 54 124 1 TS CODE
2155 REF 29 LAST 355 40,3244 3 4675 1 CAP BIT14
2156 REF 6 LAST 356 40,3245 7 0143 0 MASK COUNT
2157 REF 113 LAST 356 40,3246 10 000 0 CCS A
2158 REF 20 LAST 345 40,3247 3 4711 1 CAP TWO

CANT USE L FOR RETURN, SINCE MANY OF THE
ROUTINES CALLING DSPIN USE L AS RETURN.

LEFT IF COUNT IS ODD
RIGHT IF COUNT IS EVEN

DOES NOT USE CYL

BIT14 = 1, BLANK SIGN



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 56

E0 S4

2159 REF 41 LAST 356 40,3250 6 4712 1 AD ONE
2160 REF 9 LAST 356 40,3251 54 143 0 TS COUNT
A2161
A2162
2163 40,3252 0 0004 0 DSPIN1 INHINT
2164 REF 2 LAST 356 40,3253 50 141 0 INDEX DSREL
2165 REF 26 LAST 317 40,3254 11=023 0 CCS DSPTAB
2166 40,3255 0 3257 1 TC +2
2167 REF 6 LAST 343 40,3256 0 5640 0 TC CCSHOLE
2168 REF 42 LAST 357 40,3257 6 4712 1 AD ONE
2169 REF 1 40,3260 54 142 1 TS DSMAG
2170 REF 10 LAST 357 40,3261 50 143 1 INDEX COUNT
2171 REF 1 40,3262 7 3303 0 MASK DSMASK
2172 40,3263 0 0006 1 EXTEND
2173 REF 11 LAST 356 40,3264 60 124 0 SU CODE
2174 40,3265 0 0006 1 EXTEND
2175 REF 1 40,3266 1 3301 1 BZP DSLV
2176 REF 11 LAST 357 40,3267 50 143 1 DPRINT INDEX COUNT
2177 REF 2 LAST 357 40,3270 4 3303 0 CS DSMASK
2178 REF 2 LAST 357 40,3271 7 0142 1 MASK DSMAG
2179 REF 12 LAST 357 40,3272 6 0124 0 AD CODE
2180 REF 114 LAST 356 40,3273 4 0000 0 CS A
2181 REF 3 LAST 357 40,3274 50 141 0 INDEX DSREL
2182 REF 27 LAST 357 40,3275 57=023 1 XCH DSPTAB
2183 40,3276 0 0006 1 EXTEND
2184 REF 2 LAST 357 40,3277 6 3301 0 BZMP DSLV
2185 REF 7 LAST 317 40,3300 25=016 1 INCR NCUT
2186 40,3301 0 0003 1 DSLV RELINT
2187 REF 2 LAST 356 40,3302 0 0114 0 TC DSEXIT

2188 40,3303 00037 0 DSMASK OCT 37
2189 40,3304 01740 0 OCT 1740
2190 40,3305 02000 0 OCT 2000
2191 40,3306 03740 1 OCT 3740
R2192 FOR 11DSPIN, PUT REL ADDRESS OF DSPTAB ENTRY INTO A, 1 IN BIT11 OR 0 IN
R2193 BIT11 OF CODE.

2194 REF 4 LAST 357 40,3307 54 141 1 11DSPIN TS DSREL
2195 REF 21 LAST 356 40,3310 3 4711 1 CAP TWO
2196 REF 12 LAST 357 40,3311 54 143 0 TS COUNT
2197 REF 103 LAST 356 40,3312 56 002 0 XCH 0
2198 REF 3 LAST 357 40,3313 54 114 1 TS DSEXIT
2199 REF 2 LAST 356 40,3314 0 3252 1 TC DSPIN1
2200 REF 5 LAST 354 40,3315 0 3225 1 DSPOCTIN TC DSPIN
2201 40,3316 3 3320 0 CAP +2
2202 REF 4 LAST 342 40,3317 0 4577 0 TC BANKJUMP

BIT14 = 0, LEAVE SIGN ALONE

+0 INTO COUNT FOR RIGHT

+1 INTO COUNT FOR LEFT(SIGN LEFT ALONE)

+3 INTO COUNT FOR LEFT(TO BLANK SIGN)

IF +

IF-

SAME

MASK WITH 77740,76037,75777, OR 74037

DSPTAB ENTRY WAS -
DSPTAB ENTRY WAS +

MUST USE SAME RETURN AS DSPIN

SO DSPOCTWD DOESNT USE SWCALL



L PINBALL GAME BUTTONS AND LIGHTS

USER=5 PAGE NO. 57 E0 54

2203 REP 1 40,3320 83401 1 ENDSPOCT CADR OCTBACK
R2204 DSPALARM FINDS TC NVSUBEND IN ENTRET FOR NVSUB INITIATED ROUTINES.
R2205 ABORT WITH 01501.
R2206 DSPALARM FINDS TC ENDOPJOB IN ENTRET FOR KEYBOARD INITIATED ROUTINES.
R2207 DO TC ENTRET.

22075 REP 9 LAST 355 40,3321 4 4374 1 PREDSPAL CS VD1
22076 REP 50 LAST 358 40,3322 54 777 1 TS DSPCOUNT
2208 REP 1 40,3323 4 3342 0 DSPALARM CS NVSENDL
2209 REP 8 LAST 349 40,3324 8 0138 0 AD ENTEXIT
2210 40,3325 0 0008 1 EXTEND
2211 REP 16 LAST 311 40,3326 1 3337 1 BZF CHARALRM +2
22111 REP 1 40,3327 4 3341 0 CS MONADR
22112 REP 9 LAST 358 40,3330 8 0138 0 AD ENTEXIT
22113 40,3331 0 0008 1 EXTEND
22114 40,3332 1 3334 1 BZF +2
22115 40,3333 0 3335 1 TC +2
22116 REP 1 40,3334 0 4220 0 TC KILMONON
2212 REP 5 LAST 238 40,3335 0 4400 1 CHARALRM TC FALTON
2213 REP 37 LAST 352 40,3338 0 5112 0 TC ENDOPJOB
2214 REP 1 40,3337 0 5822 1 TC POODOO
2217 40,3340 01501 1 OCT 01501
22171 REP 2 LAST 351 40,3341 04140 0 MONADR GENADR PASTEV8
2218 REP 1 40,3342 0 4218 0 NVSENDL TC NVSUBEND
R2219 ALMCYCLE TURNS ON CHECK FAIL LIGHT, REDISPLAYS THE ORIGINAL VERR THAT
R2220 WAS EXECUTED, AND RECYCLES TO EXECUTE THE ORIGINAL VERR/NOIN COMBINATION
R2221 THAT WAS LAST EXECUTED. USED FOR BAD DATA DURING LOAD VERRS AND BY
R2222 MCIBS. ALSO BY MMCHANG IF 2 NUMERICAL CHARACTERS WERE NOT PUNCHED IN
R2223 FOR MM CODE.

IF THIS IS A MONITOR, KILL IT

NOT NVSUB INITIATED. TURN ON OPR ERROR

2224 REP 3 LAST 351 4181 SETLOC MID7 +1
22245 REP 2 LAST 351 TO 351' 17 17* COUNT 02/PIN

2225 REP 6 LAST 358 4181 0 4400 1 ALMCYCLE TC FALTON
2228 REP 3 LAST 348 4182 4 1041 1 CS VERBSAVE
2229 REP 11 LAST 351 4183 55=013 0 TS RECRET
2230 REP 50 LAST 351 4184 0 4555 0 TC BANKCALL
2231 REP 8 LAST 351 4185 62336 0 CADR UPDATVR -1
2232 REP 27 LAST 355 4186 0 4574 0 TC POSTJUMP
2233 REP 2 LAST 311 4187 82002 1 ENDALM CADR ENTER
R2234 MMCHANG USES NOIN DISPLAY UNTIL ENTER. THEN IT USES MODE DISP.
R2235 IT GOES TO MODROUT WITH THE NEW M M CODE IN A, BUT NOT DISPLAYED IN
R2236 MM LIGHTS.
R2237 IT DEMANDS 2 NUMERICAL CHARACTERS BE PUNCHED IN FOR NEW MM CODE.

TURN ON CHECK FAIL LIGHT.
GET ORIGINAL VERR THAT WAS EXECUTED
SET FOR ENTPAS0
PUTS ORIGINAL VERR INTO VERBREG AND
DISPLAYS IT IN VERR LIGHTS.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 56

E0 S4

R2238 IF NOT, IT RECYCLES.

2239 REF 1 41,3420 SETLOC DSP2BIT +10D

22395 REF 6 LAST 355 TO 356 37 764* COUNT 41/PIN

2240 REF 1 41,3420 0 3442 0 MMCHANG TC REQMM

A2241

A2242

2243 REF 16 LAST 253 41,3421 3 4706 1 CAP BITS

2244 REF 51 LAST 356 41,3422 6 0777 0 AD DSPCOUNT

2245 41,3423 0 0006 1 EXTEND

2246 41,3424 1 3426 0 BZF +2

2247 REF 16 LAST 348 41,3425 0 4161 0 TC ALMCYCLE

2248 REF 69 LAST 355 41,3426 3 4714 1 CAP ZERO

2249 REF 12 LAST 349 41,3427 57=002 1 XCH NOUNREG

2250 REF 184 LAST 355 41,3430 54 154 0 TS MPAC

2251 REF 3 LAST 323 41,3431 3 4375 1 CAP ND1

2252 REF 52 LAST 359 41,3432 54 777 1 TS DSPCOUNT

2253 REF 51 LAST 356 41,3433 0 4555 0 TC BANKCALL

2254 REF 4 LAST 317 41,3434 60502 0 CADR 2BLANK

2255 REF 10 LAST 356 41,3435 4 4374 1 CS VD1

2256 REF 53 LAST 359 41,3436 54 777 1 TS DSPCOUNT

2257 REF 185 LAST 359 41,3437 3 0154 1 CA MPAC

2258 REF 28 LAST 356 41,3440 0 4574 0 TC POSTJUMP

2259 REF 1 41,3441 10010 1 CADR MODROUTB

2260 REF 2 LAST 261 04,2010 MODROUTB = V37

2261 REF 104 LAST 357 41,3442 4 0002 1 REQMM CS 0

2262 REF 12 LAST 356 41,3443 55=013 0 TS RECRET

2263 REF 4 LAST 359 41,3444 3 4375 1 CAP ND1

2264 REF 54 LAST 359 41,3445 54 777 1 TS DSPCOUNT

2265 REF 70 LAST 359 41,3446 3 4714 1 CAP ZERO

2266 REF 13 LAST 359 41,3447 55=002 0 TS NOUNREG

2267 REF 52 LAST 359 41,3450 0 4555 0 TC BANKCALL

2268 REF 5 LAST 359 41,3451 60502 0 CADR 2BLANK

2269 REF 3 LAST 323 41,3452 0 4443 0 TC FLASHON

2270 REF 43 LAST 357 41,3453 3 4712 1 CAP ONE

2271 REF 18 LAST 346 41,3454 55=000 1 TS DECBRNCH

2272 REF 10 LAST 356 41,3455 0 0136 0 TC ENTEXIT

R2273 VBROXEC ENTERS REQUEST TO EXEC FOR ANY ADDRESS WITH ANY PRIORITY.

R2274 IT DOES ENDJOB AFTER ENTERING REQUEST. DISPLAY SYST IS RELEASED.

R2275 IT ASSUMES NOUN 26 HAS BEEN PRELOADED WITH

R2276 COMPONENT 1 PRIORITY(BITS 10-14) BIT1=0 FOR NOVAC, BIT1=1 FOR PINDVAC.

R2277 COMPONENT 2 JOB ADRES (12 BIT)

R2276 COMPONENT 3 BBCON

ENTPASHI ASSUMES THE TC REQMM AT MMCHANG
IF THIS MOVES AT ALL, MUST CHANGE
MMADREF AT ENTPASHI.

OCT20 = ND2.
DSPCOUNT MUST = -ND2.
DEMAND THAT 2 NUM CHAR WERE PUNCHED IN.

DSPCOUNT NOT= -ND2. ALARM AND RECYCLE.
DSPCOUNT = -ND2.

BLOCK NUM CHAR IN

GO THRU STANDARD LOC.

SET FOR DEC



L PINBALL GAME BUTTONS AND LIGHTS

2279	REF	29	LAST	356	41,3456	3 4712 1	VBROGEC	CAP	BIT1	
2280	REF	18	LAST	352	41,3457	7 1045 0		MASK	DSPTM1	
2281	REF	115	LAST	357	41,3480	10 000 0		CCS	A	
2282	REF	1			41,3461	0 3500 1		TC	SETVAC	
2283	REF	1			41,3482	3 4385 0		CAP	TCNOVAC	
2284	REF	186	LAST	359	41,3463	54 154 0	REQEX1	TS	MPAC	
2285	REF	30	LAST	380	41,3484	4 4712 0		CS	BIT1	
2286	REF	17	LAST	380	41,3485	7 1045 0		MASK	DSPTM1	
2287	REF	187	LAST	360	41,3468	54 180 1		TS	MPAC	+4
2288	REF	5	LAST	320	41,3487	0 4473 0	REQUESTC	TC	RELDSP	
2289	REF	5	LAST	349	41,3470	3 4233 1		CA	ENDINST	
2290	REF	168	LAST	380	41,3471	54 157 0		TS	MPAC	+3
2291					41,3472	0 0008 1		EXTEND		
2292	REF	18	LAST	360	41,3473	3 1047 0		DCA	DSPTM1	+1
2293	REF	189	LAST	380	41,3474	52 158 1		DXCH	MPAC	+1
2294	REF	190	LAST	380	41,3475	3 0180 0		CA	MPAC	+4
2295					41,3478	0 0004 0		INHINT		
2298	REF	191	LAST	380	41,3477	0 0154 1		TC	MPAC	
2297	REF	1			41,3500	3 4370 1	SETVAC	CAP	TCFINDVAC	
2298	REF	1			41,3501	0 3483 0		TC	REQEX1	
R2299	VBROWAIT ENTERS REQUEST TO WAITLIST FOR ANY ADDRESS WITH ANY DELAY.									
R2300	IT DOES ENDJOB AFTER ENTERING REQUEST,DISPLAY SYST IS RELEASED.									
R2301	IT ASSUMES NOUN 28 HAS BEEN PRELOADED WITH									
R2302	COMPONENT 1 DELAY (LO7 BITS)									
R2303	COMPONENT 2 TASK ADRES (12 BIT)									
R2304	COMPONENT 3 BBON									
2305	REF	1			41,3502	3 4388 0	VBROWAIT	CAP	TOWAIT	
2306	REF	192	LAST	360	41,3503	54 154 0		TS	MPAC	
2307	REF	19	LAST	380	41,3504	3 1045 1		CA	DSPTM1	
2308	REF	1			41,3505	0 3466 0	ENDROWT	TC	REQUESTC	-1
R2309	REQUESTC WILL PUT TASK ADRES INTO MPAC+1, BBON INTO MPAC+2,									
R2310	TC ENDJOB INTO MPAC+3. IT WILL TAKE TIME DELAY OUT OF MPAC+4 AND									
R2311	LEAVE IT IN A, INHINT AND TC MPAC.									
2312	REF	2	LAST	356	40,3343			SETLOC	NVSHENDL	+1
23125	REF	7	LAST	358 TO 356	76	739*		COUNT	40/PIN	
2313	REF	44	LAST	359	40,3343	3 4712 1	VBPROC	CAP	ONE	
2314	REF	2	LAST	339	40,3344	55*014 1		TS	LOADSTAT	
2315	REF	2	LAST	358	40,3345	0 4220 0		TC	KILMONON	
2316	REF	6	LAST	360	40,3346	0 4473 0		TC	RELDSP	
2317	REF	3	LAST	318	40,3347	0 4447 1		TC	FLASHOFF	
2318	REF	2	LAST	339	40,3350	0 3450 0		TC	RECALTST	

IF BIT1 = 1, FINDVAC
IF BIT1 = 0, NOVAC
TC NOVAC OR TC FINDVAC INTO MPAC

PRIO INTO MPAC+4 AS A TEMP

TC ENDJOB INTO MPAC+3

JOB ADRES INTO MPAC+1
BBON INTO MPAC+2
PRIO IN A

TC WAITLIST INTO MPAC
TIME DELAY

PROCEED WITHOUT DATA

TURN ON KILL MONITOR BIT

SEE IF THERE IS ANY RECALL FROM ENDIDLE



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 60

E0 S4

2319 REF 45 LAST 380 40,3351 4 4712 0 VBTERM CS ONE
2320 REF 2 LAST 321 40,3352 0 3344 1 TC VBPROC +1 TERM VERB SETS LOADSTAT NEG
R23201 PROCKEY PERFORMS THE SAME FUNCTION AS VBPROC. IT MUST BE CALLED UNDER
R23202 EXECUTIVE CONTROL, WITH CHRPRIO.
23205 REF 71 LAST 359 40,3353 3 4714 1 PROCKEY CAP ZERO SET REQRET FOR ENTER PASS 0.
23206 REF 13 LAST 359 40,3354 55=013 0 TS REQRET
23207 REF 11 LAST 359 40,3355 4 4374 1 CS VD1 BLOCK NUMERICAL CHARACTERS, SIGNS, CLEAR
23208 REF 55 LAST 359 40,3356 54 777 1 TS DSPCOUNT
23209 REF 3 LAST 381 40,3357 0 3343 0 TC VBPROC
R2321 VBRESEQ WAKES ENDIDLE AT SAME LINE AS FINAL ENTER OF LOAD (L+3).
R2322 (MAIN USE IS INTENDED AS RESPONSE TO INTERNALLY INITIATED FLASHING
R2323 DISPLAYS IN ENDIDLE. SHOULD NOT BE USED WITH LOAD VERBS, PLEASE PERFORM,
R2324 OR PLEASE MARK VERBS BECAUSE THEY ALREADY USE L+3 IN ANOTHER CONTEXT.)

2325 REF 72 LAST 381 40,3360 4 4714 0 VBRESEQ CS ZERO MAKE IT LOOK LIKE DATA IN.
2326 REF 4 LAST 381 40,3361 0 3344 1 TC VBPROC +1
R2327 FLASH IS TURNED OFF BY PROCEED WITHOUT DATA, TERMINATE, RESEQUENCE,
R2328 END OF LOAD.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 61 E0 S4

P2329 KEY RELEASE ROUTINE

R2330 THIS ROUTINE ALWAYS TURNS OFF THE UPACT LIGHT AND ALWAYS CLEARS DSPLOCK.

R2331 THE HIGHEST PRIORITY FUNCTION OF THE KEY RELEASE BUTTON IS THE
R2332 UNSUSPENDING OF A SUSPENDED MONITOR WHICH WAS EXTERNALLY INITIATED.
R2333 THIS FUNCTION IS ACCOMPLISHED BY CLEARING DSPLOCK AND TURNING OFF
R2334 THE KEY RELEASE LIGHT IF BOTH DSPLIST AND CADRSTOR ARE EMPTY.

R2335 IF NO SUCH MONITOR EXISTS, THEN RELDSP IS EXECUTED TO CLEAR DSPLOCK
R2336 AND THE EXTERNAL MONITOR BIT (FREEING THE DISPLAY SYSTEM FOR INTERNAL
R2337 USE), TURN OFF THE KEY RELEASE LIGHT, AND WAKE UP ANY JOB IN DSPLIST.

R2338 IN ADDITION IF THERE IS A JOB IN ENDIDLE, THEN CONTROL IS TRANSFERRED
R2339 TO PINBRNCH (IN DISPLAY INTERPACE ROUTINE) TO RE-EXECUTE THE SERIES OF
R23391 NVSUB CALLS ETC. THAT PRECEDED THE ENDIDLE CALL STILL Awaiting RESPONSE.
R2340 THIS FEATURE IS INTENDED FOR USE WHEN THE OPERATOR HAS BEEN REQUESTED TO
R2341 RESPOND TO SOME INTERNAL ACTION THAT USED ENDIDLE, BUT HE HAS WRITTEN
R2342 OVER THE INFORMATION ON THE DISPLAY PANEL BY SOME DISPLAYS OF HIS OWN
R2343 INITIATION WHICH DO NOT SERVE AS RESPONSES. HITTING KEY ELSE WILL
R2344 RE-ESTABLISH THE DISPLAYS TO THE STATE THEY WERE IN BEFORE HE OBTAINED
R2345 THEM, SO THAT HE CAN SEE THE WAITING REQUEST. THIS WORKS ONLY FOR
R2346 INTERNAL PROGRAMS THAT USED ENDIDLE THROUGH MARGARETS DISPLAY
R2347 SUBROUTINES.

2348	REP	14	LAST	336	40,3362	4 4710 1	VBRELDSP	CS	BIT3	
2349					40,3363	0 0006 1		EXTEND		
2350	REP	10	LAST	193	40,3364	03 011 1		WAND	DSALMOUT	TURN OFF UPACT LITE
2351	REP	2	LAST	310	40,3365	10 115 0		CCS	21/22REG	OLD DSPLOCK
2352	REP	30	LAST	356	40,3366	3 4675 1		CAP	BIT14	
2353	REP	6	LAST	351	40,3367	7 1021 1		MASK	MONSAVE1	EXTERNAL MONITOR BIT (EMB)
2354	REP	116	LAST	360	40,3370	10 000 0		CCS	A	
2355	REP	1			40,3371	0 3400 0		TC	UNSUSPEN	OLD DSPLOCK AND EMB BOTH 1, UNSUSPEND.
2356	REP	7	LAST	360	40,3372	0 4473 0	TSILTS4	TC	RELDSP	NOT UNSUSPENDING EXTERNAL MONITOR,
2357	REP	5	LAST	350	40,3373	11-042 1		CCS	CADRSTOR	RELEASE DISPLAY SYSTEM AND
2358					40,3374	0 3376 0		TC	+2	DO RE-ESTABLISH IF CADRSTOR IS FULL.
2359	REP	38	LAST	358	40,3375	0 S112 0		TC	ENDOFJOB	
2360	REP	29	LAST	359	40,3376	0 4574 0		TC	POSTJUMP	
2361	REP	4	LAST	259	40,3377	21176 1		CADR	PINBRNCH	
2362	REP	73	LAST	361	40,3400	3 4714 1	UNSUSPEN	CAP	ZERO	EXTERNAL MONITOR IS SUSPENDED,
2363	REP	5	LAST	350	40,3401	55-012 1		TS	DSPLOCK	JUST UNSUSPEND IT BY CLEARING DSPLOCK.
2364	REP	6	LAST	362	40,3402	11-042 1		CCS	CADRSTOR	TURN KEY RELEASE LIGHT OFF IF BOTH
2365	REP	39	LAST	362	40,3403	0 S112 0		TC	ENDOFJOB	CADRSTOR AND DSPLIST ARE EMPTY.
2366	REP	2	LAST	350	40,3404	0 4516 1		TC	RELDSP1	
23661	REP	40	LAST	362	40,3405	0 S112 0		TC	ENDOFJOB	
2367					40,3406				ENDRELDSP EQUALS	

L PINBALL GAME BUTTONS AND LIGHTS

USERS PAGE NO. 62 E0 84

R2368 NVSUB IS USED FOR SUB ROUTINE CALLS FROM WITHIN COMPUTER. IT CAN BE
R2369 USED TO CALL THE COMBINATION OF ANY DISPLAY, LOAD, OR MONITOR VERB
R2370 TOGETHER WITH ANY NOUN AVAILABLE TO THE KEYBOARD.
R23701 PLACE 0VVVVVVVNNNNNN INTO A.
R23702 V-S ARE THE 7 BIT VERB CODE. N-S ARE THE 7 BIT NOUN CODE.

R23703 IF NVSUB IS CALLED WITH THE FOLLOWING NEGATIVE NUMBERS (RATHER THAN THE
R23704 VERB-NOUN CODE) IN A, THEN THE DISPLAY IS BLANKED AS FOLLOWS-
R23705 -4 FULL BLANK, -3 LEAVE MODE, -2 LEAVE MODE AND VERB, -1 BLANK R-S ONLY

R2371 NVSUB CAN BE USED WITH MACH CADR TO BE SPEC BY PLACING THE CADR INTO
R2372 MPAC+2 BEFORE THE STANDARD NVSUB CALL.

R2373 NVSUB RETURNS TO 2+ CALLING LOC AFTER PERFORMING TASK, IF DISPLAY
R2374 SYSTEM IS AVAILABLE. THE NEW NOUN AND VERB CODES ARE DISPLAYED.
R2375 IF V'S =0, THE NEW NOUN CODE IS DISPLAYED ONLY(RETURN WITH NO FURTHER
R2376 ACTION). IF N-S =0, THE NEW VERB CODE IS DISPLAYED ONLY(RETURN WITH NO
R2377 FURTHER ACTION).

R2378 IT RETURNS TO 1+ CALLING LOC WITHOUT PERFORMING TASK, IF DISPLAY
R2379 SYSTEM IS BLOCKED (NOTHING IS DISPLAYED IN THIS CASE).
R2380 IT DOES TO ABORT (WITH OCT 01501) IF IT ENCOUNTERS A DISPLAY PROGRAM
R2381 ALARM CONDITION BEFORE RETURN TO CALLER.

R2382 THE DISPLAY SYSTEM IS BLOCKED BY THE DEPRESSION OF ANY
R2383 KEY, EXCEPT ERROR LIGHT RESET
R2384 IT IS RELEASED BY THE KEY RELEASE BUTTON, ALL EXTENDED VERBS,
R2385 PROCEED WITHOUT DATA, TERMINATE, RESEQUENCE, INITIALIZE EXECUTIVE,
R2386 RECALL PART OF RECALYST IF ENDIDLE WAS USED,
R2387 VB = REQUEST EXECUTIVE, VB = REQUEST WAITLIST,
R2388 MONITOR SET UP.

R23881 THE DISPLAY SYSTEM IS ALSO BLOCKED BY THE EXTERNAL MONITOR BIT, WHICH
R23882 INDICATES AN EXTERNALLY INITIATED MONITOR IS RUNNING (SEE MONITOR)

R2389 A NVSUB CALL THAT PASSES DSPLOCK AND THE EXTERNAL MONITOR BIT ENDS OLD
R23891 MONITOR.

R2390 DSPLOCK IS THE INTERLOCK FOR USE OF KEYBOARD AND DISPLAY SYSTEM WHICH
R2391 LOCKS OUT INTERNAL USE WHENEVER THERE IS EXTERNAL KEYBOARD ACTION.

R23911 NVSUB SHOULD BE USED TWICE IN SUCCESSION FOR 'PLEASE PERFORM' SITUATIONS
R23912 (SIMILARLY FOR PLEASE MARK). FIRST PLACE THE CODED NUMBER FOR WHAT
R23913 ACTION IS DESIRED OF OPERATOR INTO THE REGISTERS REFERRED TO BY THE
R23914 'CHECKLIST' NOUN. GO TO NVSUB WITH A DISPLAY VERB AND THE 'CHECKLIST'
R23915 NOUN. GO TO NVSUB AGAIN WITH THE 'PLEASE PERFORM' VERB AND ZEROS IN THE
R23916 LOW 7 BITS. THIS 'PASTES UP' THE 'PLEASE PERFORM' VERB INTO THE VERB
R23917 LIGHTS.

R23918 NVMONOPT IS AN ENTRY SIMILAR TO NVSUB, BUT REQUIRING AN ADDITIONAL



L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 63 E0 84

R239181 PARAMETER IN L. IT SHOULD BE USED ONLY WITH A MONITOR VERB-NOUN CODE IN
R239182 A. AFTER EACH MONITOR DISPLAY A *PLEASE* VERB WILL BE PASTED IN THE VERB
R239183 LIGHTS OR DATA WILL BE BLANKED (OR BOTH) ACCORDING TO THE OPTIONS
R239184 SPECIFIED IN L. IF BITS 8-14 OF L ARE OTHER THAN ZERO, THEN THEY WILL
R239185 BE INTERPRETED AS A VERB CODE AND PASTED IN THE VERB LIGHTS. (THIS VERB
R239186 CODE SHOULD DESIGNATE ONE OF THE *PLEASE* VERBS.) IF BITS 1-3 OF L ARE
R239187 OTHER THAN ZERO, THEN THEY WILL BE USED TO BLANK DATA BY BEING FED TO
R239188 BLANKSUS. IF NVMONOPT IS USED WITH A VERB OTHER THAN A MONITOR VERB,
R239189 THE PARAMETER IN L HAS NO EFFECT.

R2392 NVSUB IN FIXED-FIXED PLACES 2+CALLING LOC INTO NVOTEM, TC NVSUBEND INTO
R2393 ENTRET. (THIS WILL RESTORE OLD CALLING BANK BITS)

2394	REF	1		4170		SETLOC ENDALM +1	
23945	REF	3	LAST	358 TO 359	7 24*	COUNT 02/PIN	
2395				4170	22 007 0	NVSUB	LXCH T
2396	REF	1		4171	54 123 0	NVMONOPT	TS NVTEM
2397	REF	31	LAST	362	4172 3 4675 1	CAP	BIT14
23971	REF	7	LAST	362	4173 7 1021 1	MASK	MONSAVE1
23972	REF	6	LAST	362	4174 6 1012 0	AD	DSPLCK
23973	REF	117	LAST	362	4175 10 000 0	CCS	A
23974	REF	105	LAST	359	4176 0 0002 0	TC	0
2398	REF	46	LAST	361	4177 3 4712 1	CAP	ONE
2399	REF	106	LAST	364	4200 6 0002 0	NVSBCCM	AD 0
2400	REF	1		4201	55*037 0	TS	NVOTEM
24001	REF	4	LAST	351	4202 23*022 0	LXCH	MONSAVE2
2401	REF	3	LAST	360	4203 0 4220 0	TC	KILMONON
2402	REF	1		4204	3 4215 0	NVSBCCM	CAP NVSBRNK
2403	REF	10	LAST	128	4205 56 006 1	XCH	BRANK
24031				4206	0 0006 1	EXTEND	
24032	REF	3	LAST	236	4207 04 007 1	ROR	SUPERBANK
2404	REF	1		4210	55*040 0	TS	NVBNKTEM
24041	REF	2	LAST	236	4211 3 4215 0	CAP	PINSUPBT
24042				4212	0 0006 1	EXTEND	
24043	REF	4	LAST	364	4213 01 007 1	WRITE	SUPERBANK
2405	REF	1		4214	0 2000 0	TC	NVSUBB
2406	REF	56	LAST	361	0777	ERANK=	DSPCOUNT
2407	REF	2	LAST	318	4215 62101 0	NVSBRRNK	BBCON NVSUB1
24071	REF	2	LAST	364	4215	PINSUPBT =	NVSBRRNK
2412	REF	2	LAST	364	4216 53*040 0	NVSBEND	DXCH NVOTEM
2413	REF	1		4217	0 5122 0	TC	SUPDXCHZ
2414	REF	1		41,3506		SETLOC ENDRQWT +1	
241405	REF	7	LAST	359 TO 360	54 838*	COUNT 41/PIN	



L PINBALL GAME BUTTONS AND LIGHTS

USER=8 PAGE NO. 64 E0 84

R241412 BLANKDSP BLANKS DISPLAY ACCORDING TO OPTION NUMBER IN NVTEMP AS FOLLOWS

R241415 -4 FULL BLANK, -3 LEAVE MODE, -2 LEAVE MODE AND VERB, -1 BLANK R-S ONLY

241419	REF	8	LAST	356	41,3506	6 4716 0	BLANKDSP AD	SEVEN	7,8,9, OR 10 (A HAD 0,1,2, OR 3)
241422					41,3507	0 0004 0	INHINT		
241425	REF	13	LAST	357	41,3510	54 124 1	TS	CODE	BLANK SPECIFIED DSPTAB
241429	REF	16	LAST	344	41,3511	4 4677 1	CS	BIT12	
241432	REF	14	LAST	365	41,3512	50 124 0	INDEX	CODE	
241435	REF	26	LAST	357	41,3513	57*023 1	XCH	DSPTAB	
241439	REF	116	LAST	364	41,3514	10 000 0	CCS	A	
241442	REF	6	LAST	357	41,3515	25*016 1	INCR	NOUT	
241445					41,3516	0 3517 1	TC	+1	
241449	REF	15	LAST	365	41,3517	10 124 1	CCS	CODE	
241452	REF	1			41,3520	0 3510 0	TC	BLANKDSP +2	
241455					41,3521	0 0003 1	RELINT		
241459	REF	2	LAST	364	41,3522	50 123 1	INDEX	NVTEMP	
241462					41,3523	0 3530 1	TC	+5	
241465					41,3524	0 3525 0	TC	+1	NVTEMP HAS -4 (NEVER TOUCH MODREG)
241469	REF	19	LAST	351	41,3525	55*001 0	TS	VERBREG	-3
241472	REF	14	LAST	359	41,3526	55*002 0	TS	NOUNREG	-2
241475	REF	12	LAST	339	41,3527	55*015 0	TS	CLPASS	-1
241479	REF	12	LAST	361	41,3530	4 4374 1	CS	VD1	
241482	REF	57	LAST	364	41,3531	54 777 1	TS	DSPCOUNT	
241485	REF	4	LAST	360	41,3532	0 4447 1	TC	FLASHOFF	PROTECT AGAINST INVISIBLE FLASH
241489	REF	1			41,3533	0 3556 1	TC	ENTSET -2	ZEROS REQRET
2415	REF	2	LAST	365	41,3534	3 3560 1	NVSUB1	CAP	ENTSET
2416	REF	6	LAST	351	41,3535	54 136 1	TS	ENTRET	IN BANK
24161	REF	3	LAST	365	41,3536	10 123 0	CCS	NVTEMP	SET RETURN TO NVSUBEND
24162					41,3537	0 3543 0	TC	+4	WHAT NOW
24163	REF	19	LAST	327	41,3540	0 2350 0	TC	GODSPALM	NORMAL NVSUB CALL (EXECUTE VN OR PASTE)
24164	REF	2	LAST	365	41,3541	0 3506 1	TC	BLANKDSP	BLANK DISPLAY A5 SPECIFIED
24165	REF	20	LAST	365	41,3542	0 2350 0	TC	GODSPALM	
2417	REF	5	LAST	351	41,3543	3 6043 0	CAP	LOW7	
2418	REF	4	LAST	365	41,3544	7 0123 0	MASK	NVTEMP	
2419	REF	193	LAST	360	41,3545	54 157 0	TS	MPAC	+3
2420	REF	5	LAST	365	41,3546	3 0123 1	CA	NVTEMP	TEMP FOR NOUN (CANT USE MPAC. DSPDECVN
2422	REF	5	LAST	351	41,3547	54 023 1	TS	EDOP	USES MPAC, +1, +2
2423	REF	6	LAST	365	41,3550	3 0023 0	CA	EDOP	RIGHT 7
2424	REF	194	LAST	365	41,3551	54 160 1	TS	MPAC	+4
A2425									TEMP FOR VERB (CANT USE MPAC+1. DSPDECVN
2426	REF	195	LAST	365	41,3552	10 157 0	CCS	MPAC	+3
2427	REF	1			41,3553	0 3561 0	TC	NVSUB2	TEST NOUN
2428	REF	196	LAST	365	41,3554	3 0160 0	CA	MPAC	+4
2429	REF	9	LAST	356	41,3555	0 2336 0	TC	UPDATVB	-1
24291	REF	74	LAST	362	41,3556	3 4714 1	CAP	ZERO	IF NOUN = +0, DISPLAY VERB. THEN RETURN
24292	REF	14	LAST	361	41,3557	55*013 0	TS	REQRET	ZERO REQRET SO THAT PASTED VERBS CAN
2430	REF	2	LAST	358	41,3560	0 4216 0	ENTSET	TC	NVSUBEND
2431	REF	197	LAST	365	41,3561	10 160 1	NVSUB2	CCS	MPAC +4
2432					41,3562	0 3566 1	TC	+4	TEST VERB
									IF VERB NOT +0, GO ON



L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 65 E0 S4

```

2433 REF 198 LAST 365 41,3563 3 0157 1 CA MPAC +3
2434 REF 2 LAST 351 41,3564 0 2318 1 TC UPDATNN -1
2435 REF 3 LAST 365 41,3565 0 4218 0 TC NVSUBEND
2436 REF 199 LAST 366 41,3566 3 0156 0 CA MPAC +2
2437 REF 200 LAST 366 41,3567 54 161 0 TS MPAC +5
2438 REF 201 LAST 366 41,3570 3 0180 0 CA MPAC +4
2439 REF 10 LAST 365 41,3571 0 2338 0 TC UPDATVB -1
2440 REF 202 LAST 366 41,3572 3 0157 1 CA MPAC +3
2441 REF 3 LAST 366 41,3573 0 2318 1 TC UPDATNN -1
2442 REF 75 LAST 365 41,3574 3 4714 1 CAP ZERO
2443 REF 3 LAST 360 41,3575 55=014 1 TS LOADSTAT
2444 REF 13 LAST 365 41,3576 55=015 0 TS CLPASS
2445 REF 15 LAST 365 41,3577 55=013 0 TS REQRET
2446 REF 203 LAST 366 41,3600 3 0161 1 CA MPAC +5
2447 REF 204 LAST 366 41,3601 54 156 1 TS MPAC +2
2448 REF 3 LAST 318 41,3602 0 2035 0 ENDNVSB1 TC ENTPAS0
R2449 IF INTERNAL MACH CADR TO BE SPECIFIED, MPAC+2 WILL BE PLACED INTO
R2450 NOUNCADR IN ENTPAS0 (INTMCTBS ).
2451 REF 4 LAST 366 4220 SETLOC NVSUBEND +2
24515 REF 4 LAST 364 TO 364' 24 48* COUNT 02/PIN

```

IF VERB = +0, DISPLAY NOUN. THEN RETURN

TEMP FOR MACH CADR TO BE SPEC. (DSPDECVN
USES MPAC, +1, +2)

IF BOTH NOUN AND VERB NOT +0, DISPLAY
BOTH AND GO TO ENTPAS0.

SET FOR WAITING FOR DATA CONDITION.

SET REQRET FOR PASS 0.
RESTORES MACH CADR TO BE SPEC TO MPAC+2
FOR USE IN INTMCTBS (IN ENTPAS0).

```

A2452
2453 REF 26 LAST 339 4220 3 4674 0 KILMONON CAP BIT15
2454 REF 6 LAST 364 4221 55=021 1 TS MONSAVE1
A2455
2456 REF 107 LAST 364 4222 0 0002 0 TC 0
R2459 LOADSTAT +0 INACTIVE(WAITING FOR DATA). SET BY NVSUB
R2460 +1 PROCEED NO DATA. SET BY SPECIAL VERB
R2461 -1 TERMINATE SET BY SPECIAL VERB
R2462 -0 DATA IN SET BY END OF LOAD ROUTINE
R2463 OR RESEQUENCE SET BY VERB 32
R2464 L TC ENDIDLE (FIXED FIXED)
R2465 ROUTINES THAT REQUEST LOADS THROUGH NVSUB SHOULD USE ENDIDLE WHILE
R2466 WAITING FOR THE DATA TO BE LOADED. ENDIDLE PUTS CURRENT JOB TO SLEEP.
R2467 ENDIDLE CANNOT BE CALLED FROM ERASABLE OR P/P MEMORY,
R2468 SINCE JOBSLEEP AND JOBWAKE CAN HANDLE ONLY FIXED BANKS.
R2469 RECALST TESTS LOADSTAT AND WAKES JOB UP TO,
R2470 L+1 FOR TERMINATE
R2471 L+2 FOR PROCEED WITHOUT DATA
R2472 L+3 FOR DATA IN, OR RESEQUENCE
R2473 IT DOES NOTHING IF LOADSTAT INDICATES WAITING FOR DATA.

```

FORCE BIT 15 OF MONSAVE1 TO 1.
THIS IS THE KILL MONITOR BIT.
TURN OFF BIT 14, THE EXTERNAL
MONITOR BIT.



L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 66

EO 84

R2474 ENDIDLE ABORTS (WITH CODE 01208) IF A SECOND JOB ATTEMPTS TO GO TO SLEEP
R2475 IN PINBALL. IN PARTICULAR, IF AN ATTEMPT IS MADE TO GO TO ENDIDLE WHEN
R2476 1) CADRSTOR NOT= +0. THIS IS THE CASE WHERE THE CAPACITY OF ENDIDLE IS
R2477 EXCEEDED. (+NZ INDICATES A JOB IS ALREADY ASLEEP DUE TO ENDIDLE.)
R2478 2) DSPLIST NOT= +0. THIS INDICATES A JOB IS ALREADY ASLEEP DUE TO
R2479 NVSUBUSY.

2480	REP	108	LAST	368	4223	22 002 0	ENDIDLE	LXCH	Q
2481	REP	1			4224	0 4234 0		TC	ISCADR+0
2482	REP	1			4225	0 4240 0		TC	ISLIST+0
2483	REP	41	LAST	352	4226	3 0001 0		CA	L
2484	REP	4	LAST	265	4227	7 4747 0		MAK	LOW10
2485	REP	1			4230	6 0004 0		AD	FRANK
2486	REP	7	LAST	362	4231	55=042 1		TS	CADRSTOR
2487	REP	1			4232	0 5070 0		TC	JOBSLEEP
2488	REP	41	LAST	362	4233	0 5112 0	ENDINST	TC	ENDOFJOB
2489	REP	8	LAST	367	4234	11=042 1	ISCADR+0	CCS	CADRSTOR
2490	REP	1			4235	0 4243 0		TC	DSPABORT
2491	REP	109	LAST	367	4236	0 0002 0		TC	Q
2492	REP	2	LAST	367	4237	0 4243 0		TC	DSPABORT

RETURN ADDRESS INTO L.
ABORT IF CADRSTOR NOT= +0
ABORT IF DSPLIST NOT= +0
DONT SET DSPLOCK TO 1 SO CAN USE
ENDIDLE WITH NVSUB INITIATED MONITOR.
SAME STRATEGY FOR CADR AS MAKECADR.

2493	REP	2	LAST	188	4240	11=043 0	ISLIST+0	CCS	DSPLIST
2494	REP	3	LAST	367	4241	0 4243 0		TC	DSPABORT
2495	REP	110	LAST	367	4242	0 0002 0		TC	Q
2496	REP	2	LAST	358	4243	0 5622 1	DSPABORT	TC	POODOO
2497					4244	01208 1		OCT	01208

ABORTS (CODE 01208) IF CADRSTOR NOT= +0.
RETURNS IF CADRSTOR = +0.

ABORTS (CODE 01208) IF DSPLIST NOT= +0.
RETURNS IF DSPLIST = +0.

R2498 JAMTERM ALLOWS PROGRAMS TO PERFORM THE TERMINATE FUNCTION.
R2499 IT DOES ENDOFJOB.

2500	REP	3	LAST	364	4245	3 4215 0	JAMTERM	CAP	PINSUPBT
2501					4246	0 0008 1		EXTEND	
25011	REP	5	LAST	364	4247	01 007 1		WRITE	SUPERBANK
25012	REP	1			4250	3 4258 1		CAP	34DEC
25013	REP	16	LAST	368	4251	55=013 0		TS	REORET
2502	REP	13	LAST	365	4252	4 4374 1		CS	VD1
2503	REP	58	LAST	365	4253	54 777 1		TS	DSPCOUNT
2504	REP	30	LAST	362	4254	0 4574 0		TC	POSTJUMP
2505	REP	2	LAST	321	4255	61351 1		CADR	VBIERM

LEAVE ENTER SET FOR ENTRPASSO.

2506 4256 00042 1 34DEC DEC 34
R2507 JAMPROC ALLOWS PROGRAMS TO PERFORM THE PROCEED/PROCEED WITHOUT DATA
R2508 FUNCTION. IT DOES ENDOFJOB.

L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 67 E0 S4

2509	REP	4	LAST	387	4257	3 4215 0	JAMPROC	CAP	PINSUBBT
2510					4260	0 0008 1		EXTEND	
25101	REP	6	LAST	387	4261	01 007 1		WRITE	SUPERBANK
25102	REP	1			4262	3 4270 0		CAP	33DEC
25103	REP	17	LAST	387	4263	55*013 0		TS	REQRET
2511	REP	14	LAST	387	4264	4 4374 1		CS	VD1
2512	REP	59	LAST	387	4265	54 777 1		TS	DSPCOUNT
2513	REP	31	LAST	387	4266	0 4574 0		TC	POSTJUMP
2514	REP	5	LAST	381	4267	61343 1		CADR	VBPROC

LEAVE ENTER SET FOR ENTPASS0.

2515 4270 00041 1 33DEC DEC 33
R2532 BLANKSUB BLANKS ANY COMBINATION OF R1, R2, R3.
R2533 CALL WITH BLANKING CODE IN A.
R2534 BIT1=1 BLANKS R1, BIT2=1 BLANKS R2, BIT3=1 BLANKS R3.
R2535 ANY COMBINATION OF THESE BITS IS ACCEPTED.

R2536 DSPCOUNT IS RESTORED TO STATE IT WAS IN BEFORE BLANKSUB WAS EXECUTED.

2538	REP	9	LAST	385	4271	7 4716 1	BLANKSUB MASK	SEVEN
25381	REP	6	LAST	385	4272	54 123 0	TS	NVTEMP
2539	REP	32	LAST	384	4273	3 4675 1	CAP	BIT14
2540	REP	9	LAST	388	4274	7 1021 1	MASK	MONSAVE1
25401	REP	7	LAST	384	4275	6 1012 0	AD	DSPLOCK
25402	REP	119	LAST	385	4276	10 000 0	CCS	A
25403	REP	111	LAST	387	4277	0 0002 0	TC	0
25404	REP	112	LAST	388	4300	24 002 0	INCR	0

STORE BLANKING CODE IN NVTEMP.

EXTERNAL MONITOR BIT

DSP SYST BLOCKED. RET TO 1+ CALLING LOC
DSP SYST AVAILABLE
SET RETURN FOR 2+ CALLING LOC

25411	REP	7	LAST	388	4301	10 123 0	CCS	NVTEMP
25412					4302	1 4304 0	TCF	+2
25413	REP	113	LAST	388	4303	0 0002 0	TC	0
2542	REP	114	LAST	388	4304	22 002 0	LXCH	0
2544	REP	1			4305	3 4316 1	CAP	BLANKBANK
2545	REP	11	LAST	384	4306	56 006 1	XCH	BRANK
25451					4307	0 0006 1	EXTEND	
25452	REP	7	LAST	388	4310	04 007 1	ROR	SUPERBANK
2546	REP	40	LAST	326	4311	52 131 0	DXCH	RUP
25461	REP	5	LAST	388	4312	3 4215 0	CAP	PINSUBBT
25462					4313	0 0006 1	EXTEND	
25463	REP	8	LAST	388	4314	01 007 1	WRITE	SUPERBANK
2547	REP	1			4315	0 3406 0	TC	BLANKSUB1

SAVE OLD SUPERBITS.

NOTHING TO BLANK. RET TO 2+ CALLING LOC
SET RETURN FOR 2 + CALLING LOC

2548	REP	60	LAST	388	0777		BRANK=	DSPCOUNT
25481	REP	2	LAST	388	4316	60101 1	BLANKBANK	BBCON BLANKSUB1
2549					4317		ENDBLPP	EQUALS

2550	REP	1			40,3406		SETLOC	ENDREIDS
25505	REP	8	LAST	360 TO 364	35 774*		COUNT	40/PIN



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 66 E0 84

2551	REF	61	LAST	368	40,3408	3 0777 0	BLKSUB1	CA	DSPCOUNT	SAVE OLD DSPCOUNT FOR LATER RESTORATION
25511	REF	41	LAST	368	40,3407	54 132 0		TS	RUF +2	
25512	REF	31	LAST	360	40,3410	3 4712 1		CAP	BIT1	TEST BIT1. SEE IF R1 TO BE BLANKED.
2552	REF	1			40,3411	0 3430 0		TC	TESTBIT	
2553	REF	13	LAST	352	40,3412	3 4333 0		CAP	R1D1	
2554	REF	4	LAST	332	40,3413	0 2436 1		TC	SBLANK -1	
2555	REF	20	LAST	218	40,3414	3 4711 1		CAP	BIT2	TEST BIT 2. SEE IF R2 TO BE BLANKED.
2556	REF	2	LAST	389	40,3415	0 3430 0		TC	TESTBIT	
2557	REF	5	LAST	354	40,3416	3 4334 1		CAP	R2D1	
2558	REF	5	LAST	389	40,3417	0 2438 1		TC	SBLANK -1	
2559	REF	15	LAST	362	40,3420	3 4710 0		CAP	BIT3	TEST BIT3. SEE IF R3 TO BE BLANKED.
2560	REF	3	LAST	369	40,3421	0 3430 0		TC	TESTBIT	
2561	REF	5	LAST	333	40,3422	3 4335 0		CAP	R3D1	
2562	REF	6	LAST	369	40,3423	0 2436 1		TC	SBLANK -1	
2563	REF	42	LAST	389	40,3424	3 0132 1		CA	RUF +2	RESTORE DSPCOUNT TO STATE IT HAD
2564	REF	62	LAST	369	40,3425	54 777 1		TS	DSPCOUNT	BEFORE BLANKSUB.
2565	REF	43	LAST	369	40,3428	52 131 0		DXCH	RUF	CALL L+2 DIRECTLY.
2566	REF	2	LAST	384	40,3427	0 5123 1		TC	SUPDXCHZ +1	DTCB WITH SUPERBIT SWITCHING
2567	REF	8	LAST	388	40,3430	7 0123 0	TESTBIT	MASK	NVTEMP	NVTEMP CONTAINS BLANKING CODE.
2568	REF	120	LAST	368	40,3431	10 000 0		CCS	A	
2569	REF	115	LAST	368	40,3432	0 0002 0		TC	0	IF CURRENT BIT = 1, RETURN TO L+1.
2570	REF	116	LAST	389	40,3433	50 002 0		INDEX	0	IF CURRENT BIT = 0, RETURN TO L+3.
2571					40,3434	0 0002 0		TC	2	

2572 40,3435 ENDRSUB1 EQUALS

R257205 DSPMM DOES NOT DISPLAY MODREG DIRECTLY. IT PUTS IN EXEC REQUEST WITH
R257206 PRIO 30000 FOR DSPMMJB AND RETURNS TO CALLER.

R257207 IF MODREG CONTAINS -0, DSPMMJB BLANKS THE MODE LIGHTS.

R257209 DSPMM MUST BE IN BANK 27 OR LOWER, SO IT CAN BE CALLED VIA BANKCALL.

25721					07,2440			BANK	7	
257215	REF	1			04,2000			SETLOC	PINBALL4	
257217					04,2537			BANK		
257218	REF	1						COUNT	07/PIN	
25722	REF	117	LAST	389	04,2537	56 002 0	DSPMM	XCH	0	
25723	REF	205	LAST	366	04,2540	54 154 0		TS	MPAC	
25724					04,2541	0 0004 0		INHINT		
25725	REF	3	LAST	350	04,2542	3 4371 0		CAP	CHRPRI0	
25726	REF	12	LAST	350	04,2543	0 5027 1		TC	NOVAC	
25727	REF	83	LAST	369	0777			EBANK	DSPCOUNT	
25728	REF	1			04,2544	03435 0		ZCADR	DSPMMJB	
25728	REF	1			04,2545	80101 1				
257285					04,2548	0 0003 1		RELINT		



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 69 E0 84

25729 REP 206 LAST 369 04,2547 0 0154 1 ENDSPMM TC MPAC

R2573 DSPMM PLACE MAJOR MODE CODE INTO MODREG

25735 REP 1 40,3435 SETLOC ENDSUB1

25736 REP 9 LAST 368 TO 369 23 797* COUNT 40/PIN

2574 REP 1 40,3435 3 4376 1 DSPMMJB CAP MD1

2575 REP 64 LAST 369 40,3436 56 777 0 XCH DSPCOUNT

2576 REP 1 40,3437 54 140 0 TS DSPMMTEM

2579 REP 6 LAST 255 40,3440 11*011 1 CCS MODREG

2580 REP 47 LAST 364 40,3441 6 4712 1 AD ONE

25801 REP 4 LAST 355 40,3442 0 3211 0 TC DSPDECVN

25802 REP 6 LAST 359 40,3443 0 3445 1 TC +2

25803 REP 6 LAST 359 40,3444 0 2502 1 TC 2BLANK

2581 REP 2 LAST 370 40,3445 56 140 1 XCH DSPMMTEM

2582 REP 65 LAST 370 40,3446 54 777 1 TS DSPCOUNT

2583 REP 42 LAST 367 40,3447 0 5112 0 TC ENDOPJOB

R2584 RECALST IS ENTERED DIRECTLY AFTER DATA IS LOADED (OR RESEQUENCE VERR IS
R2585 EXECUTED), TERMINATE VERR IS EXECUTED, OR PROCEED WITHOUT DATA VERR IS
R2586 EXECUTED. IT WAKES UP JOB THAT DID TC ENDIDLE.

R2587 IF CADRSTOR NOT= +0, IT PUTS +0 INTO DSPLOCK, AND TURNS OFF KEY RLSE

R2588 LIGHT IF DSPLIST IS EMPTY (LEAVES KEY RLSE LIGHT ALONE IF NOT EMPTY).

2589 REP 9 LAST 367 40,3450 11*042 1 RECALST CCS CADRSTOR

2590 REP 1 40,3451 0 3453 0 TC RECAL1

2591 REP 43 LAST 370 40,3452 0 5112 0 TC ENDOPJOB

2592 REP 76 LAST 366 40,3453 3 4714 1 RECAL1 CAP ZERO

2593 REP 10 LAST 370 40,3454 57*042 0 XCH CADRSTOR

2594 REP 1 40,3455 0 0004 0 INHINT

2595 REP 1 40,3456 0 5074 1 TC JOBWAKE

2596 REP 4 LAST 366 40,3457 11*014 1 CCS LOADSTAT

2597 REP 1 40,3460 0 3502 0 TC DOPROC

2598 REP 44 LAST 370 40,3461 0 5112 0 TC ENDOPJOB

2599 REP 1 40,3462 0 3500 1 TC DOTERM

2600 REP 22 LAST 357 40,3463 3 4711 1 CAP TWO

2601 REP 1 40,3464 50 064 0 RECAL2 INDEX LOCCTR

2602 REP 1 40,3465 6 0164 1 AD LOC

2603 REP 2 LAST 370 40,3466 50 064 0 INDEX LOCCTR

2604 REP 2 LAST 370 40,3467 54 164 0 TS LOC

26041 REP 15 LAST 365 40,3470 3 1002 1 CA NOUNREG

26042 REP 42 LAST 367 40,3471 54 001 1 TS L

26043 REP 20 LAST 365 40,3472 3 1001 1 CA VERRREG

26044 REP 3 LAST 370 40,3473 50 064 0 INDEX LOCCTR

26045 REP 207 LAST 370 40,3474 52 155 1 DXCH MPAC

2605 40,3475 0 0003 1 RELINT

GETS HERE THRU DSPMM

SAVE DSPCOUNT

IF MODREG IS + OR +0, DISPLAY MODREG

IF MODREG IS -NZ, DO NOTHING

IF MODREG IS -0, BLANK MM

RESTORE DSPCOUNT

NORMAL EXIT IF KEYBOARD INITIATED

+ PROCEED WITHOUT DATA
PATHOLOGICAL CASE EXIT
- TERMINATE
-0 DATA IN OR RESEQUENCE

LOC IS + FOR BASIC JOBS

SAVE VERR IN MPAC, NOUN IN MPAC+1 AT
TIME OF RESPONSE TO ENDIDLE FOR
POSSIBLE LATER TESTING BY JOB THAT HAS
BEEN WAKED UP.



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 70 E0 54

2606	REF	8	LAST	362	40,3476	0 4473 0	RECAL3	TC	RELDSP
2607	REF	45	LAST	370	40,3477	0 5112 0		TC	ENDOFJOB
2808	REF	77	LAST	370	40,3500	3 4714 1	DOTERM	CAP	ZERO
2809	REF	1			40,3501	0 3484 1		TC	RECAL2
2810	REF	48	LAST	370	40,3502	3 4712 1	DOPROC	CAP	ONE
2811	REF	2	LAST	371	40,3503	0 3484 1		TC	RECAL2



L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 71 E0 S4

P2612 MISCELLANEOUS SERVICE ROUTINES IN FIXED/FIXED

2613 REP 1 4317 SETLOC ENDBLPP

26135 REP 5 LAST 366 TO 368 63 111* COUNT 02/PIN

R2614 SETNCADR E CADR ARRIVES IN A. IT IS STORED IN NOUNCADR. EBANK BITS
R2615 ARE SET. E ADRES IS DERIVED AND PUT INTO NOUNADO.

2616	REP	6	LAST	352	4317	55=017 1	SETNCADR TS	NOUNCADR	STORE ECADR
2617	REP	16	LAST	296	4320	54 003 0	TS	EBANK	SET EBANK BITS
2618	REP	1			4321	7 4373 0	MASK	LOW6	
2619	REP	1			4322	6 4744 1	AD	OCT1400	
2620	REP	29	LAST	347	4323	54 145 0	TS	NOUNADO	PUT E ADRES INTO NOUNADO
2621	REP	116	LAST	369	4324	0 0002 0	TC	0	
R2622	SETNADO								
R2623									

GETS E CADR FROM NOUNCADR, SETS EBANK BITS, DERIVES
E ADRES AND PUTS IT INTO NOUNADO.

2624	REP	9	LAST	372	4325	3 1017 0	SETNADO CA	NOUNCADR	
2625	REP	7	LAST	341	4326	1 4320 0	TCF	SETNCADR +1	
R2626	SETEBANK								
R2627									

E CADR ARRIVES IN A. EBANK BITS ARE SET. E ADRES IS
DERIVED AND LEFT IN A.

2628	REP	17	LAST	372	4327	54 003 0	SETEBANK TS	EBANK	SET EBANK BITS
2629	REP	2	LAST	372	4330	7 4373 0	MASK	LOW6	
2630	REP	2	LAST	372	4331	6 4744 1	AD	OCT1400	E ADRES LEFT IN A
2631	REP	119	LAST	372	4332	0 0002 0	TC	0	
2632					4333	00016 0	R1D1	OCT	16
2633					4334	00011 1	R2D1	OCT	11
2634					4335	00004 0	R3D1	OCT	4

THESE 3 CONSTANTS FORM A PACKED TABLE.
DONT SEPARATE.

2635	REP	7	LAST	356	4336	54 020 1	RIGHTS TS	CYR	
2636	REP	6	LAST	372	4337	4 0020 1	CS	CYR	
2637	REP	9	LAST	372	4340	4 0020 1	CS	CYR	
2638	REP	10	LAST	372	4341	4 0020 1	CS	CYR	
2639	REP	11	LAST	372	4342	4 0020 1	CS	CYR	
2640	REP	12	LAST	372	4343	56 020 0	XCH	CYR	
2641	REP	120	LAST	372	4344	0 0002 0	TC	0	

2642	REP	13	LAST	356	4345	54 022 0	LEFTS TS	CYL	
2643	REP	14	LAST	372	4346	4 0022 0	CS	CYL	
2644	REP	15	LAST	372	4347	4 0022 0	CS	CYL	
2645	REP	16	LAST	372	4350	4 0022 0	CS	CYL	



L PINBALL GAME. BUTTONS AND LIGHTS

USER-S PAGE NO. 72 E0.84

2646	REP	17	LAST	372	4351	4	0022	0	CS	CYL
2647	REP	18	LAST	373	4352	58	022	1	XCH	CYL
2648	REP	121	LAST	372	4353	0	0002	0	TC	0
2649					4354	6	0000	1	SLEPTS	DOUBLE
2650					4355	6	0000	1		DOUBLE
2651					4356	6	0000	1		DOUBLE
2652					4357	6	0000	1		DOUBLE
2653					4380	6	0000	1		DOUBLE
2654	REP	122	LAST	373	4381	0	0002	0	TC	0
2655					4382	00037	0		LOWS	OCT 37
2656					4383	01740	0		MIDS	OCT 1740
2657					4384	78000	0		HIS	OCT 78000
2658	REP	13	LAST	369	4365	0	5027	1	TCNOVAC	TC NOVAC
2659	REP	13	LAST	350	4368	0	5140	1	TOWAIT	TC WAITLIST
2660	REP	14	LAST	350	4367	0	5213	1	TCTSKOVR	TC TASKOVER
2661	REP	13	LAST	261	4370	0	5042	1	TCFINDVC	TC FINDVAC
2662					4371	30000	1		CHRPRI	OCT 30000
2663					4372	03777	0		LOW11	OCT 3777
2664	REP	6	LAST	341	4372				B12-1	EQUALS LOW11
2665					4373	00377	1		LOW8	OCT 377
2667					4374	00023	0		VD1	OCT 23
2668					4375	00021	1		ND1	OCT 21
2669					4378	00025	0		MD1	OCT 25
2670					4377	00012	1		BINCON	DEC 10
2671	REP	28	LAST	317	4400	3	4704	0	FALTON	CA BIT7
2672					4401	0	0006	1		EXTEND
2673	REP	11	LAST	362	4402	05	011	1		WOR DSALMOUT
2674	REP	123	LAST	373	4403	0	0002	0		TC 0
2675	REP	29	LAST	373	4404	4	4704	1	FALTOR	CS BIT7
2676					4405	0	0008	1		EXTEND
2677	REP	12	LAST	373	4406	03	011	1		WAND DSALMOUT
2676	REP	124	LAST	373	4407	0	0002	0		TC 0
2679	REP	17	LAST	359	4410	3	4708	1	RELDSPON	CAP BITS
2680					4411	0	0006	1		EXTEND
2681	REP	13	LAST	373	4412	05	011	1		WOR DSALMOUT
2682	REP	125	LAST	373	4413	0	0002	0		TC 0

THESE 3 CONSTANTS FORM A PACKED TABLE.
DONT SEPARATE.
MUST STAY HERE

EXEC PRIORITY OF CHARIN

THESE 3 CONSTANTS FORM A PACKED TABLE.
DONT SEPARATE.

TURN ON OPERATOR ERROR LIGHT

BIT 7 OF CHANNEL 11

TURN OFF OPERATOR ERROR LIGHT

BIT 7 OF CHANNEL 11

TURN ON KEY RELEASE LIGHT

BIT 5 OF CHANNEL 11



L PINBALL GAME BUTTONS AND LIGHTS

USER=S PAGE NO. 73 E0 S4

2683 4414 0 0006 1 LODSAMPT EXTEND
2684 REF 10 LAST 267 4415 3 0025 0 DCA TIME2
2685 REF 5 LAST 276 4416 52 014 0 DXCH SAMPTIME
2686 REF 126 LAST 373 4417 0 0002 0 TC 0
2687 4420 0 0006 1 TPSEL1 EXTEND
2688 REF 206 LAST 370 4421 3 0156 0 DCA MPAC +1
2689 REF 209 LAST 374 4422 20 156 1 DAS MPAC +1
2690 REF 210 LAST 374 4423 6 0154 1 AD MPAC
2691 REF 211 LAST 374 4424 26 154 0 ADS MPAC
2692 4425 54 007 1 TS 7
2693 REF 127 LAST 374 4426 0 0002 0 TC 0
2694 REF 7 LAST 346 4427 54 162 0 TS MPAC+6
2695 REF 126 LAST 374 4430 0 0002 0 TC 0
R2696 IF MPAC, +1 ARE EACH +NZ OR +0 AND C(A)=-0, SHORIMP WRONGLY GIVES +0.
R2697 IF MPAC, +1 ARE EACH -NZ OR -0 AND C(A)=+0, SHORIMP WRONGLY GIVES +0.
R2698 PRSHRIMP FIXES FIRST CASE ONLY, BY MERELY TESTING C(A) AND IF IT = -0,
R2699 SETTING RESULT TO -0.
R2700 (DO NOT USE PRSHRIMP UNLESS MPAC, +1 ARE EACH +NZ OR +0, AS THEY ARE
R2701 WHEN THEY CONTAIN THE SF CONSTANTS.)

2702 REF 2 LAST 66 4431 54 135 1 PRSHRIMP TS MPTIMP
2703 REF 121 LAST 369 4432 10 000 0 CCS A
2704 REF 3 LAST 374 4433 3 0135 0 CA MPTIMP
2705 REF 8 LAST 353 4434 1 7257 1 TCF SHORIMP +1
2706 4435 1 4433 0 TCF -2
2707 REF 78 LAST 371 4436 4 4714 0 CS ZERO
2708 REF 212 LAST 374 4437 54 154 0 TS MPAC
2709 REF 213 LAST 374 4440 54 155 1 TS MPAC +1
2710 REF 214 LAST 374 4441 54 156 1 TS MPAC +2
2711 REF 129 LAST 374 4442 0 0002 0 TC 0
2712 REF 26 LAST 292 4443 3 4705 1 FLASHON CAP BIT6
2713 4444 0 0006 1 EXTEND
2714 REF 14 LAST 373 4445 05 011 1 WOR DSALMOUT
2715 REF 130 LAST 374 4446 0 0002 0 TC 0
2716 REF 27 LAST 374 4447 4 4705 0 FLASHOFF CS BIT6
2717 4450 0 0006 1 EXTEND
2718 REF 15 LAST 374 4451 03 011 1 WAND DSALMOUT
2719 REF 131 LAST 374 4452 0 0002 0 TC 0

SHIFTS MPAC, +1, +2 LEFT 1
LEAVES OVPIND SET TO +/- 1 FOR OP/UP
TS A DOES NOT CHANGE A ON OP/UP.
NO NET OP/UP
MPAC +6 SET TO +/-1 FOR OP/UP
C(A) +, DO REGULAR SHORIMP
C(A) +0, DO REGULAR SHORIMP
C(A) -, DO REGULAR SHORIMP
C(A) -0, FORCE RESULT TO -0 AND RETURN.
TURN ON V/N FLASH
BIT 6 OF CHANNEL 11
TURN OFF V/N FLASH
BIT 6 OF CHANNEL 11



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 74

E0 34

R2720 INTERNAL USE OF KEYBOARD AND DISPLAY PROGRAM

R2721 USER MUST SCHEDULE CALLS TO NVSUB SO THAT THERE IS NO CONFLICT OF USE OR
R2722 CONFUSION TO OPERATOR. THE OLD GEARLOCK (INTERNAL/INTERNAL INTERLOCK)
R2723 HAS BEEN REMOVED AND THE INTERNAL USER NO LONGER HAS THE PROTECTION THIS
R2724 OFFERED.

R2725 THERE ARE TWO WAYS A JOB CAN BE PUT TO SLEEP BY THE KEYBOARD + DISPLAY
R2726 PROGRAM. 1) BY ENDIDLE

R2727 2) BY NVSUBUSY

R2728 THE BASIC CONVENTION IS THAT ONLY ONE JOB WILL BE PERMITTED ASLEEP VIA
R2729 THE KEYBOARD + DISPLAY PROGRAM AT A TIME. IF A JOB ATTEMPTS TO GO TO
R2730 SLEEP BY MEANS OF (1) OR (2) AND THERE IS ALREADY A JOB ASLEEP THAT WAS
R2731 PUT TO SLEEP BY (1) OR (2), THEN AN ABORT IS CAUSED.

R2732 THE CALLING SEQUENCE FOR NVSUB IS

R2733 CAP V/N

R2734 L TC NVSUB

R2735 L+1 RETURN HERE IF OPERATOR HAS INTERVENED

R2736 L+2 RETURN HERE AFTER EXECUTION.

R2737 A ROUTINE CALLED NVSUBUSY IS PROVIDED (USE IS OPTIONAL) TO PUT
R2738 YOUR JOB TO SLEEP UNTIL THE OPERATOR RELEASES THE KEYBOARD + DISPLAY
R2739 SYSTEM. NVSUBUSY ALSO TURNS ON THE KEY RELEASE LIGHT.

R2740 NVSUBUSY CANNOT BE CALLED FROM ERASABLE OR P/P MEMORY,
R2741 SINCE JOBSLEEP AND JOBSLEEP CAN HANDLE ONLY FIXED BANKS.

R2742 THE CALLING SEQUENCE IS

R2743 CAP WAKEFCADR

R2744 TC NVSUBUSY

R2745

R2746 NVSUBUSY IS INTENDED FOR USE WHEN AN INTERNAL PROGRAM FINDS THE OPERATOR
R2747 IS USING THE KEYBOARD + DISPLAY PROGRAM (BY HIS OWN INITIATION). IT IS

R2748 NOT INTENDED FOR USE WHEN ONE INTERNAL PROGRAM FINDS ANOTHER INTERNAL

R2749 PROGRAM USING THE KEYBOARD + DISPLAY PROGRAM.

R2750 NVSUBUSY ABORTS (WITH CODE 01206) IF A SECOND JOB ATTEMPTS TO GO TO

R2751 SLEEP IN PINBALL. IN PARTICULAR, IF AN ATTEMPT IS MADE TO GO TO NVSUBUSY

R2752 WHEN

R2753 1) DSPLIST NOT= +0. THIS IS THE CASE WHERE THE CAPACITY OF THE DSPLIST
R2754 IS EXCEEDED.

R2755 2) CADRSTOR NOT= +0. THIS INDICATES THAT A JOB IS ALREADY USING



L PINBALL GAME BUTTONS AND LIGHTS

USER'S PAGE NO. 75 E0 84

R2756 ENDIDLE. (+-NZ INDICATE A JOB IS ALREADY ASLEEP DUE TO ENDIDLE.)

2757	REF	1		4453	4	4460	0	PRENVBSY	CS	ZK+3
2758	REF	132	LAST	374	4454	8	0002	0	AD	0
2759	REF	2	LAST	387	4455	8	0004	0	AD	FRANK
2760	REF	32	LAST	386	4456	0	4574	0	NVSUBSY	TC
2761	REF	1			4457	10550	0		CADR	NVSUBSY1
2762					4460	02003	0	ZK+3	OCT	2003

SPECIAL ENTRANCE FOR ROUTINES IN FIXED BANKS ONLY DESIRING THE PCADR OF(LOC FROM WHICH THE TC PRENVBSY WAS DONE) -2 TO BE ENTERED.

R27625 NVSUBSY1 MUST BE IN BANK 27 OR LOWER, SO IT WILL PUT CALLER TO SLEEP
R27626 WITH HIS PROPER SUPERBITS.

2763	REF	1		04,2550					SETLOC	ENDSPM +1
27635	REF	2	LAST	389 TO 370'	9	9*			COUNT	07/PIN

2764	REF	43	LAST	370	04,2550	54	001	1	NVSUBSY1	TS	L
2769	REF	2	LAST	387	04,2551	0	4234	0	TC	ISCADR+0	
2770	REF	2	LAST	387	04,2552	0	4240	0	TC	ISLIST+0	
2771	REF	3	LAST	352	04,2553	0	4410	0	TC	RELDSPON	
2772	REF	44	LAST	378	04,2554	3	0001	0	CA	L	
2773	REF	3	LAST	387	04,2555	55	043	0	TS	DSPLIST	
2774	REF	2	LAST	387	04,2556	0	5070	0	ENDNVBSY	TC	JOBSLEEP

R2775 NVSWAIT IS A SPECIAL ENTRANCE FOR ROUTINES IN FIXED BANKS ONLY. IF
R2776 SYSTEM IS NOT BUSY, IT EXECUTES V/N AND RETURNS TO L+1 (L= LOC FROM
R2777 WHICH THE TC NVSWAIT WAS DONE). IF SYSTEM IS BUSY, IT PUTS CALLING JOB
R2778 TO SLEEP WITH L-1 GOING INTO LIST FOR EVENTUAL WAKING UP WHEN SYSTEM
R2779 IS NOT BUSY.

ABORT IF CADRSTOR NOT= +0.
ABORT IF DSPLIST NOT= +0.

2780	REF	1		4461					SETLOC	NVSUBSY +3
27805	REF	6	LAST	372 TO 376'	96	209*			COUNT	02/PIN

2781				4461	22	007	0	NVSWAIT	LXCH	7	ZERO NVMONOPT OPTIONS
2782	REF	9	LAST	389	4462	54	123	0	TS	NVTEMP	
2783	REF	33	LAST	386	4463	3	4675	1	CAP	BIT14	
27831	REF	10	LAST	386	4464	7	1021	1	MASK	MONSAVE1	EXTERNAL MONITOR BIT
27832	REF	8	LAST	386	4465	8	1012	0	AD	DSBLOCK	
27833	REF	122	LAST	374	4466	10	000	0	CCS	A	
27834	REF	1			4467	1	4471	0	TCF	NVSWT1	BUSY
2784	REF	1			4470	1	4200	0	TCF	NVSBOM	FREE. NVSUB WILL SAVE L+1 FOR RETURN AFTER EXECUTION.
A2785											L+2. PRENVBSY WILL PUT L-1 INTO LIST AND GO TO SLEEP.
2786	REF	133	LAST	376	4471	24	002	0	NVSWT1	INCR	0
2787	REF	1			4472	1	4453	0	TCF	PRENVBSY	

R2786 RELDSP IS USED BY VBPROC, VBTERM, VBROEXEC, VBROWAIT, VBRELDSP, EXTENDED
R2789 VERB DISPATCHER, VBRESEQ, RECALTST.
R2790 RELDSP1 IS USED BY MONITOR SET UP, VBRELDSP.
2791 REF 134 LAST 376 4473 56 002 0 RELDSP XCH 0 SET DSBLOCK TO +0, TURN RELDSP LIGHT



L PINBALL GAME BUTTONS AND LIGHTS

USBR-S PAGE NO. 78

E0 S4

2792	REP	1		4474	54 144 1	TS	RELRET
27921	REP	34	LAST 378	4475	4 4875 0	CS	BIT14
27922				4478	0 0004 0	INHINT	
27923	REP	11	LAST 378	4477	7 1021 1	MASK	MONSAVE1
27924	REP	12	LAST 377	4500	55=021 1	TS	MONSAVE1
2793	REP	4	LAST 378	4501	11=043 0	CCS	DSPLIST
2794				4502	0 4504 1	TC	+2
2795	REP	1		4503	0 4507 1	TC	RELDSP2
2798	REP	79	LAST 374	4504	3 4714 1	CAP	ZERO
2797	REP	5	LAST 377	4505	57=043 1	XCH	DSPLIST
2799	REP	2	LAST 370	4508	0 5074 1	TC	JOBWAKE
2800				4507	0 0003 1	RELDSP2	RELINT
2801	REP	18	LAST 373	4510	4 4708 0	CS	BITS
2802				4511	0 0008 1	EXTEND	
2803	REP	18	LAST 374	4512	03 011 1	WAND	DSALMOUT
2804	REP	80	LAST 377	4513	3 4714 1	CAP	ZERO
2805	REP	9	LAST 378	4514	55=012 1	TS	DSPLCK
2807	REP	2	LAST 377	4515	0 0144 0	TC	RELRET
2808	REP	135	LAST 378	4518	58 002 0	RELDSP1	XCH 0
2809	REP	3	LAST 377	4517	54 144 1	TS	RELRET
A2810							
A2811							
2812	REP	6	LAST 377	4520	11=043 0	CCS	DSPLIST
2813				4521	0 4523 1	TC	+2
2814	REP	2	LAST 377	4522	0 4507 1	TC	RELDSP2
2815	REP	81	LAST 377	4523	3 4714 1	CAP	ZERO
2818	REP	10	LAST 377	4524	55=012 1	TS	DSPLCK
2817	REP	4	LAST 377	4525	0 0144 0	TC	RELRET
2818				4528		ENDPINBF	EQUALS

OFF, SEARCH DSPLIST

TURN OFF EXTERNAL MONITOR BIT

LIST EMPTY

TURN OFF KEY RELEASE LIGHT
(BIT 5 OF CHANNEL 11)

SET DSPLCK TO +0. NO DSPLIST SEARCH.
TURN KEY RLSE LIGHT OFF IF DSPLIST IS
EMPTY. LEAVE KEY RLSE LIGHT ALONE IF
DSPLIST IS NOT EMPTY.

+ NOT EMPTY. LEAVE KEY RLSE LIGHT ALONE
+0 EMPTY. TURN OFF KEY RLSE LIGHT
- NOT EMPTY. LEAVE KEY RLSE LIGHT ALONE



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28, 1968 KOOLADE .089 PAGE 378

L PINBALL GAME BUTTONS AND LIGHTS

USER-S PAGE NO. 77 E0 S4

F28181 PINTEST IS NEEDED FOR AUTO CHECK OF PINBALL.

28182 REF 2 LAST 230 43,2002

PINTEST EQUALS LST2FAN



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 78

EO 54

P2819 VBTSLTS TURNS ON ALL DISPLAY PANEL LIGHTS. AFTER 5 SEC, IT TURNS
R2820 OFF THE CAUTION AND STATUS LIGHTS.

2821	REF	1		41,3603			SETLOC ENDVSB1 +1	
28215	REF	8	LAST	364	TO	366	61 899*	COUNT 41/PIN
2822				41,3603	0	0004	0	VBTSLTS INHINT
2823	REF	32	LAST	369		41,3604	4 4712 0	CS BIT1
2824	REF	20	LAST	183		41,3605	7 1321 1	MASK IMODES33
2825	REF	33	LAST	379		41,3606	6 4712 1	AD BIT1
2826	REF	21	LAST	379		41,3607	55=321 1	TS IMODES33
2827	REF	1				41,3610	3 3644 1	CAP TSTCON1
2828						41,3611	0 0006 1	EXTEND
2829	REF	17	LAST	377		41,3612	05 011 1	WOR DSALMOJT
2830	REF	1				41,3613	3 3645 0	CAP TSTCON2
2831	REF	29	LAST	365		41,3614	55=036 1	TS DSPTAB +11D
2832	REF	20	LAST	299		41,3615	3 4701 0	CAP BIT10
2833						41,3616	0 0006 1	EXTEND
2834	REF	3	LAST	186		41,3617	05 013 0	WOR CHAN13
2835	REF	3	LAST	312		41,3620	3 4377 0	CAP TEN
2836	REF	1				41,3621	54 117 1	TS ERONT
2837	REF	1				41,3622	4 3642 0	CS FULLDSP
2838	REF	2	LAST	379		41,3623	50 117 0	INDEX ERONT
2839	REF	30	LAST	379		41,3624	55=023 0	TS DSPTAB
2840	REF	3	LAST	379		41,3625	10 117 1	CCS ERONT
2841	REF	1				41,3626	0 3621 1	TC TSLTS1
2842	REF	1				41,3627	4 3643 1	CS FULLDSP1
2843	REF	31	LAST	379		41,3630	55=024 1	TS DSPTAB +1
2844	REF	32	LAST	379		41,3631	55=027 1	TS DSPTAB +4
2845	REF	33	LAST	379		41,3632	55=031 0	TS DSPTAB +6
2846	REF	3	LAST	199		41,3633	3 4717 1	CAP ELEVEN
2847	REF	9	LAST	365		41,3634	55=016 0	TS NOJT
2849	REF	1				41,3635	3 3647 1	CAP SHOLTS
2851	REF	14	LAST	373		41,3636	0 5140 1	TC WAITLIST
2852	REF	34	LAST	379		1023		BRANK= DSPTAB
2853	REF	1				41,3637	03650 1	ZCADR TSLTS2
2853	REF	1				41,3640	62102 0	
2854	REF	46	LAST	371		41,3641	0 5112 0	TC ENDOFJOB
A2855								
A2856								
2857						41,3642	05675 0	FULLDSP OCT 05675
2858						41,3643	07675 1	FULLDSP1 OCT 07675
2859						41,3644	00175 1	TSTCON1 OCT 00175
A2860								
A2861								
2862						41,3645	40650 0	TSTCON2 OCT 40650

SET BIT 1 OF IMODES33 SO IMMON WONT
TURN OUT ANY LAMPS.

TURN ON UPLINK ACTIVITY, TEMP, KEY RLSE,
V/N FLASH, OPERATOR ERROR.

TURN ON NO ATT, GIMBAL LOCK, TRACKER,
PROG ALM.

TURN ON TEST ALARM OUTBIT

TURN ON 3 PLUS SIGNS

DSPLCK IS LEFT BUSY (FROM KEYBOARD
ACTION) UNTIL TSLTS3 TO INSURE THAT
LIGHTS TEST WILL BE SEEN.
DISPLAY ALL 8'S
DISPLAY ALL 8'S AND +

UPLINK ACTIVITY, TEMP, KEY RLSE,
V/N FLASH, OPERATOR ERROR.
DSPTAB+11D BITS 4,6,8,9.



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 79 E0 S4

A2863
2864 41,3646 00115 1 TSTCON3 OCT 00115
A2865
2866 41,3647 00764 1 SHOLTS OCT 764
2867 REF 4 LAST 369 41,3650 3 4371 0 TSTLTS2 CAP CHRPRIO
2868 REF 14 LAST 373 41,3651 0 5027 1 TC NOVAC
2869 REF 35 LAST 379 1023 BRANK= DSPTAB
2870 REF 1 41,3652 03655 1 ZCADR TSTLTS3
2870 REF 1 41,3653 62102 0
2871 REF 15 LAST 373 41,3654 0 5213 1 TC TASKOVER
2872 REF 1 41,3655 4 3648 1 TSTLTS3 CS TSTCON3
2873 41,3656 0 0004 0 INHINT
2874 41,3657 0 0006 1 EXTEND
2875 REF 18 LAST 379 41,3660 03 011 1 WAND DSALMOUT
2876 REF 21 LAST 379 41,3661 4 4701 1 CS BIT10
2877 41,3662 0 0006 1 EXTEND
2878 REF 4 LAST 379 41,3663 03 013 0 WAND CHAN13
28781 REF 22 LAST 297 41,3664 3 4707 0 CAP BIT4
28782 41,3665 0 0006 1 EXTEND
28783 REF 23 LAST 243 41,3668 02 012 0 RAND CHAN12
2879 REF 27 LAST 366 41,3667 6 4674 0 AD BIT15
2880 REF 36 LAST 380 41,3670 55=036 1 TS DSPTAB +11D
2881 REF 1 41,3671 4 3713 0 CS 13-11,1
2882 REF 22 LAST 379 41,3672 7 1321 1 MASK IMODES33
2883 REF 7 LAST 251 41,3673 6 4763 1 AD PRIO16
2884 REF 23 LAST 380 41,3674 55=321 1 TS IMODES33

2885 REF 1 41,3675 4 3714 1 CS OCT55000
2886 REF 38 LAST 193 41,3676 7 1320 0 MASK IMODES30
2887 REF 2 LAST 155 41,3677 6 4762 0 AD PRIO15
2888 REF 39 LAST 380 41,3700 55=320 0 TS IMODES30

2889 REF 33 LAST 218 41,3701 4 1331 0 CS OPTMODES
2890 REF 30 LAST 373 41,3702 7 4704 1 MASK BIT7
2891 REF 34 LAST 380 41,3703 27=331 0 ADS OPTMODES
2893 41,3704 0 0003 1 RELINT

2894 REF 53 LAST 359 41,3705 0 4555 0 TC BANKCALL
2895 REF 1 41,3706 10537 1 CADR DSPRM
2896 REF 4 LAST 364 41,3707 0 4220 0 TC KILMONON
2897 REF 5 LAST 365 41,3710 0 4447 1 TC FLASHOFF
2898 REF 33 LAST 376 41,3711 0 4574 0 TC POSTJUMP
2899 REF 1 41,3712 61372 0 CADR TSTLTS4
2901 41,3713 16001 1 13-11,1 OCT 16001
2903 41,3714 55000 1 OCT55000 OCT 55000
2904 41,3715 ENDPINS2 EQUALS

NO ATT, GIMBAL LOCK, TRACKER, PROG ALM.
CHAN 11 BITS 1, 3, 4, 7.
UPLINK ACTIVITY, TEMP, OPERATOR ERROR.
5 SEC
CALLED BY WAITLIST

CALLED BY EXECUTIVE

TURN OFF UPLINK ACTIVITY, TEMP,
OPERATOR ERROR.
TURN OFF TEST ALARM OUTBIT

MAKE NO ATT FOLLOW BIT 4 OF CHANNEL 12
(NO ATT LIGHT ON IF IN COARSE ALIGN)

TURN OFF AUTO, HOLD, FREE, SPARE,
GIMBAL LOCK, SPARE, TRACKER, PROG ALM
SET BITS TO INDICATE ALL LAMPS OUT. TEST
LIGHTS COMPLETE.

15000.

REDISPLAY C(MODREG)

TURN ON KILL MONITOR BIT.
TURN OFF V/N FLASH.
DOES RELDSP AND GOES TO PINBRNCH IF
ENDIDLE IS AWAITING OPERATOR RESPONSE.



L PINBALL GAME: BUTTONS AND LIGHTS

USER=8 PAGE NO. 80 E0 S4

R2905 ERROR LIGHT RESET (RSET) TURNS OFF,
R2906 UPLINK ACTIVITY, AUTO, HOLD, FREE, OPERATOR ERROR,
R2907 PROG ALM, TRACKER FAIL.
R2908 LEAVES GIMBAL LOCK AND NO ATT ALONE.
R2909 IT ALSO ZEROES THE 'TEST ALARM' OUT BIT, WHICH TURNS OFF STBY, RESTART.
R2910 IT ALSO SETS 'CAUTION RESET' TO 1.
R2911 IT ALSO FORCES BIT 12 OF ALL DSPTAB ENTRIES TO 1.

2912	REP	2	LAST	370	40,3504				SETLOC DOPROC +2	
29125	REP	10	LAST	370 TO 372	39	838*			COUNT 40/PIN	
2913	REP	3	LAST	362	40,3504	56 115 1	ERROR	XCH	21/22REG	RESTORE ORIGINAL C(DSPLOCK). THUS ERROR
2914	REP	11	LAST	377	40,3505	55*012 1		TS	DSPLOCK	LIGHT RESET LEAVES DSPLOCK UNCHANGED.
2915					40,3508	0 0004 0		INHINT		
2916	REP	22	LAST	380	40,3507	3 4701 0		CAP	BIT10	TURN ON 'CAUTION RESET' OUTBIT
2917					40,3510	0 0008 1		EXTEND		
2918	REP	19	LAST	380	40,3511	05 011 1		WOR	DSALMOUT	BIT10 CHAN 11
2919	REP	1			40,3512	3 3572 1		CAP	GL+NOATT	LEAVE GIMBAL LOCK AND NO ATT INTACT,
2920	REP	37	LAST	380	40,3513	7 1036 1		MASK	DSPTAB +11D	TURNING OFF AUTO, HOLD, FREE,
2921	REP	28	LAST	380	40,3514	6 4874 0		AD	BIT15	PROG ALARM, AND TRACKER.
2922	REP	38	LAST	381	40,3515	55*036 1		TS	DSPTAB +11D	
2923	REP	8	LAST	380	40,3516	4 4763 0		CS	PRIO16	RESET FAIL BITS WHICH GENERATE PROG
2924	REP	24	LAST	380	40,3517	7 1321 1		MASK	IMODES33	ALARM SO THAT IF THE FAILURE STILL
2925	REP	9	LAST	381	40,3520	6 4763 1		AD	PRIO16	EXISTS, THE ALARM WILL COME BACK.
2926	REP	25	LAST	381	40,3521	55*321 1		TS	IMODES33	
2927	REP	23	LAST	381	40,3522	4 4701 1		CS	BIT10	
2928	REP	40	LAST	380	40,3523	7 1320 0		MASK	IMODES30	
2929	REP	24	LAST	381	40,3524	6 4701 0		AD	BIT10	
2930	REP	41	LAST	381	40,3525	55*320 0		TS	IMODES30	
2931	REP	35	LAST	380	40,3526	4 1331 0		CS	OPTIMODES	
2932	REP	31	LAST	380	40,3527	7 4704 1		MASK	BIT7	
2933	REP	36	LAST	381	40,3530	27*331 0		ADS	OPTIMODES	
2935	REP	25	LAST	381	40,3531	4 4701 1		CS	BIT10	TURN OFF 'TEST ALARM' OUTBIT.
2936					40,3532	0 0008 1		EXTEND		
2937	REP	5	LAST	380	40,3533	03 013 0		WAND	CHAN13	
2938	REP	1			40,3534	4 3570 1		CS	ERCON	TURN OFF UPLINK ACTIVITY,
2939					40,3535	0 0008 1		EXTEND		OPERATOR ERROR.
2940	REP	20	LAST	381	40,3536	03 011 1		WAND	DSALMOUT	
2941	REP	2	LAST	353	40,3537	3 4377 0	TSTAB	CAP	BINCON	(DEC 10)
2942	REP	4	LAST	379	40,3540	54 117 1		TS	ERCON	ERCON = COUNT
2943					40,3541	0 0004 0		INHINT		
2944	REP	5	LAST	381	40,3542	50 117 0		INDEX	ERCON	
2945	REP	39	LAST	381	40,3543	11*023 0		CCS	DSPTAB	
2946	REP	49	LAST	371	40,3544	6 4712 1		AD	ONE	
2947	REP	1			40,3545	0 3552 0		TC	ERPLUS	
2948	REP	50	LAST	381	40,3546	6 4712 1		AD	ONE	
2949	REP	123	LAST	376	40,3547	4 0000 0	ERMINUS	CS	A	
2950	REP	1			40,3550	7 3573 1		MASK	NOTBIT12	
2951	REP	1			40,3551	0 3555 1		TC	ERCON	



L PINBALL GAME BUTTONS AND LIGHTS

USER=3 PAGE NO. 81 E0 S4

2952	REF	124	LAST	381	40,3552	4 0000 0	ERPLUS	CS	A
2953	REF	2	LAST	381	40,3553	7 3573 1		MASK	NOTBIT12
2954	REF	125	LAST	382	40,3554	4 0000 0		CS	A
2955	REF	6	LAST	381	40,3555	50 117 0	ERCOM	INDEX	ERONT
2956	REF	40	LAST	381	40,3556	55*023 0		TS	DSPTAB
2957					40,3557	0 0003 1		RELINT	
2958	REF	7	LAST	382	40,3580	10 117 1		CCS	ERONT
2959	REF	1			40,3581	0 3540 0		TC	TSTAB +1
2960	REF	62	LAST	377	40,3582	3 4714 1		CAP	ZERO
2961	REF	5	LAST	266	40,3583	54 375 1		TS	FAILREG
29611	REF	6	LAST	382	40,3584	54 376 1		TS	FAILREG +1
29612	REF	7	LAST	382	40,3585	54 377 0		TS	FAILREG +2
2962	REF	2	LAST	60	40,3586	55*357 0		TS	SPAIL
2963	REF	47	LAST	379	40,3587	0 5112 0		TC	ENDOFJOB
2964					40,3570	00104 1	ERCON	OCT	104
A2965									
2966					40,3571	00240 1	BITS6,8	OCT	240
29665					40,3572	00050 1	GL+NOATT	OCT	00050
2967					40,3573	73777 1	NOTBIT12	OCT	73777
2968					40,3574		ENDPINS1	EQUALS	

MIGHT WANT TO RESET CLPASS, DECBRNCH,
ETC.CHAN 11 BITS 3,7.
UPLINK ACTIVITY, AND OPERATOR ERROR.
NO ATT AND GIMBAL LOCK LAMPS



L R60,R62

USER'S PAGE NO. 1 E0 94

1500 34,2002 BANK 34
1501 REP 1 27,2000 SETLOC MANUEVER
1502 27,2000 BANK

1503 REP 1 1146 EBANK= TEMPR80

1504 REP 1 COUNT 27/R60
R15041

R150411 R60CSM
R150413 REV 13 CONFORMS TO GSOP CHAPTER FOUR REVISION LOGIC 09 JAN 18,1968
R150415

1505 REP 1 27,2000 0 4604 1 R60CSM TC MAKECADR
1506 REP 2 LAST 383 27,2001 55-146 1 TS TEMPR80

R1507 INSERT PRIODSP CHECK WITH R22 (V08N49) WITH JENNINGS BRODEUR

1510	REP	28	LAST	374	27,2002	3 4705 1	REDOMANN CAP	BITS	
1511	REP	6	LAST	257	27,2003	7 0101 0	MASK	FLAGWRD5	IS 3-AXIS FLAG SET
1512	REP	128	LAST	382	27,2004	10 000 0	CCS	A	
1513	REP	1			27,2005	1 2013 0	TCF	TOBALL	YES
1514	REP	9	LAST	288	27,2008	0 6006 1	TC	INTPRET	
1515					27,2007	77624 1	CALL		
1516	REP	1			27,2010	58128 1		VECPPOINT	TO COMPUTE FINAL ANGLES
1517	REP	2	LAST	248	27,2011	01156 1	STORE	CPHI	STORE FINAL ANGLES - CPHI, CTHETA, CPSI
1518					27,2012	77776 1	EXIT		
1519	REP	1			27,2013	3 2125 0	TOBALL	CAP	V08N18
1520	REP	54	LAST	380	27,2014	0 4555 0	TC	BANKCALL	
1521	REP	1			27,2015	21038 1	CADR	GOPERF2R	DISPLAY PLEASE PERFORM AUTO MANUEVER
1522	REP	1			27,2016	0 2114 1	TC	R61TEST	
1523	REP	1			27,2017	0 2023 1	TC	REDOMANC	PROCEED
1524	REP	1			27,2020	1 2052 0	TCF	ENDMANU1	ENTER I.E. FINISHED WITH R60
1525	REP	1			27,2021	0 2056 0	TC	CHKLINUS	TO CHECK FOR PRIORITY DISPLAYS
1526	REP	48	LAST	382	27,2022	0 5112 0	TC	ENDOFJOB	
1529	REP	29	LAST	383	27,2023	3 4705 1	REDOMANC	CAP	BITS
1530	REP	7	LAST	383	27,2024	7 0101 0	MASK	FLAGWRD5	IS 3-AXIS FLAG SET
1531	REP	127	LAST	383	27,2025	10 000 0	CCS	A	
1532	REP	1			27,2026	1 2034 0	TCF	TOBALLC	YES
1533	REP	10	LAST	383	27,2027	0 6006 1	TC	INTPRET	
1534					27,2030	77624 1	CALL		
1535	REP	2	LAST	383	27,2031	56126 1		VECPPOINT	TO COMPUTE FINAL ANGLES
1536	REP	3	LAST	383	27,2032	01156 1	STORE	CPHI	STORE ANGLES
1537					27,2033	77776 1	EXIT		
1538	REP	7	LAST	248	27,2034	3 4371 0	TOBALLC	CAP	PRI030

IS MODE AUTO AND CTL GNC



L R60,R62

USER=3 PAGE NO. 2 E2 S4

1539				27,2035	0 0008 1	EXTEND	
1540	REF	1		27,2036	06 031 0	RXOR	CHAN31
1541	REF	2	LAST 162	27,2037	7 7707 1	MASK	13,14,15
1542				27,2040	0 0008 1	EXTEND	
1543				27,2041	1 2043 0	BZF	+2
154301	REF	2	LAST 383	27,2042	1 2013 0	TCP	TORALL
1548	REF	2	LAST 383	27,2043	3 2125 0	CAP	V06N18
1549	REF	55	LAST 383	27,2044	0 4555 0	TC	BANKCALL
1550	REF	1		27,2045	20802 1	CADR	GODSPR
1551	REF	2	LAST 383	27,2046	0 2056 0	TC	CHKLINUS
1552	REF	56	LAST 364	27,2047	0 4555 0	STARTINV TC	BANKCALL
1553	REF	1		27,2050	17547 1	CADR	GOMANUR
1555	REF	3	LAST 384	27,2051	1 2013 0	ENDMANUV TCP	TORALL
1566	REF	19	LAST 281	27,2052	0 5447 0	ENDMANU1 TC	DOWNFLAG
1567	REF	1		27,2053	00124 0	ADRES	3AXISPLG
1568	REF	3	LAST 383	27,2054	31=146 0	CAE	TEMPR60
1569	REF	5	LAST 357	27,2055	0 4577 0	TC	BANKJUMP
1570	REF	3	LAST 231	27,2056	4 0100 1	CHKLINUS CS	FLAGWRD4
1571	REF	19	LAST 365	27,2057	7 4677 1	MASK	BIT12
1572	REF	128	LAST 383	27,2060	10 000 0	CCS	A
157201	REF	136	LAST 377	27,2061	0 0002 0	TC	0
157202	REF	137	LAST 364	27,2062	3 0002 0	CA	0
157204	REF	215	LAST 374	27,2063	54 156 1	TS	MPAC +2
15721	REF	13	LAST 354	27,2064	4 6214 1	CS	THREE
157212	REF	2	LAST 69	27,2065	6 0133 0	AD	RUF2
1573	REF	2	LAST 215	27,2066	55=053 1	TS	TRASE1
1560	REF	5	LAST 280	27,2067	0 5301 0	TC	PHASCHNG
1581				27,2070	00071 1	OCT	71
1586	REF	32	LAST 381	27,2071	3 4704 0	CAP	BIT7
1587	REF	1		27,2072	0 5415 1	TC	LINUS
1588	REF	216	LAST 364	27,2073	0 0156 0	TC	MPAC +2
15881	REF	19	LAST 377	27,2074	3 4706 1	RELINUS CAP	BIT5
158812	REF	10	LAST 253	27,2075	7 0075 1	MASK	FLAGWRD1
158813				27,2076	0 0008 1	EXTEND	
158814	REF	1		27,2077	1 2111 0	BZF	GOREDO20
158815	REF	13	LAST 261	27,2100	0 5435 0	TC	UPFLAG
158816	REF	1		27,2101	00077 1	ADRES	PDSPFLAG
15882	REF	14	LAST 384	27,2102	0 5435 0	TC	UPFLAG
158821	REF	1		27,2103	00024 1	ADRES	TARG1PLG
158822	REF	83	LAST 382	27,2104	3 4714 1	CAP	ZERO

AUTO, NON-FLASH N18
NOT AUTO

SET UP NON-FLASHING V06 N18

FINISHED MANUEVER

RESET 3-AXIS FLAG
BIT 6 FLAG 5

IS PRIORITY DISPLAY FLAG SET

NO - EXIT

SAVE RETURN
OBTAIN LOCATION FOR RESTART.
HOLDS 0 OF LAST DISPLAY

1.7 SPOT FOR RELINUS

GO SET BITS FOR PRIORITY DISPLAY

IS TRACK FLAG ON

NO

R60 PRIODSP FLAG

FOR R52

RESET TO ZERO, SINCE



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28,1988 KOOLADE .089 PAGE 385

L R60,R62

USER-S PAGE NO. 3 E2 S4

158823	REP	21	LAST	253	27,2105	55=303 1	TS	OPTIND
15883	REP	1			27,2108	3 4781 0	CAP	PRI014
15884	REP	3	LAST	249	27,2107	0 5103 0	TC	PRI0CHG
15885	REP	3	LAST	384	27,2110	0 1053 0	TC	TRASE1
15888	REP	6	LAST	384	27,2111	0 5301 0	TC	PHASCHG
15887					27,2112	00111 0	OCT	111
15888	REP	49	LAST	383	27,2113	0 5112 0	TC	ENDOFJOB
1589	REP	7	LAST	370	27,2114	3 1011 0	R61TEST	CA MODREG
15891					27,2115	0 0008 1		EXTEND
15892	REP	2	LAST	383	27,2118	1 2052 0	BZF	ENDMANU1
15893	REP	4	LAST	384	27,2117	3 0100 0	CA	FLAGVFD4
1590	REP	20	LAST	384	27,2120	7 4877 1	MASK	BIT12
1591					27,2121	0 0008 1		EXTEND
1592	REP	2	LAST	185	27,2122	1 4108 0	BZF	GOTOPOOH
1593	REP	1			27,2123	0 4550 0	TC	GOTOV58
1594					27,2124	20100 1	BIT14+7	OCT 20100
1595					27,2125	01422 1	V08N18	VN 0618

OPTIND WAS SET TO -1 BY V379

RESTORE ORIGINAL PRIORITY

1.11 FOR PIKUP20

ARE WE IN P00. IF YES THIS MUST BE
VERB49 OR VERB89 SO DO ENDEXT.
RESET 3-AXIS d RETURN. USER DOES ENDEXT
ARE WE IN R61 (P20)

NO
YES



L R60,R62

USER-S PAGE NO. 4 E2 S4

P1597 PROGRAM DESCRIPTION - VECPOINT

R1598 THIS INTERPRETIVE SUBROUTINE MAY BE USED TO POINT A SPACECRAFT AXIS IN A DESIRED DIRECTION. THE AXIS
 R1600 TO BE POINTED MUST APPEAR AS A HALF UNIT DOUBLE PRECISION VECTOR IN SUCCESSIVE LOCATIONS OF ERASABLE MEMORY
 R1602 BEGINNING WITH THE LOCATION CALLED SCAXIS. THE COMPONENTS OF THIS VECTOR ARE GIVEN IN SPACECRAFT COORDINATES.
 R1604 THE DIRECTION IN WHICH THIS AXIS IS TO BE POINTED MUST APPEAR AS A HALF UNIT DOUBLE PRECISION VECTOR IN
 R1606 SUCCESSIVE LOCATIONS OF ERASABLE MEMORY BEGINNING WITH THE ADDRESS CALLED POINTVSM. THE COMPONENTS OF THIS
 R1606 VECTOR ARE GIVEN IN STABLE NUMBER COORDINATES. WITH THIS INFORMATION VECPOINT COMPUTES A SET OF THREE GIMBAL
 R1610 ANGLES (2S COMPLIMENT) CORRESPONDING TO THE CROSS-PRODUCT ROTATION BETWEEN SCAXIS AND POINTVSM AND STORES THEM
 R1612 IN TMPAC) BEFORE RETURNING TO THE CALLER.

R1613 THIS ROTATION, HOWEVER, MAY BRING THE S/C INTO GIMBAL LOCK. WHEN POINTING A VECTOR IN THE Y-Z PLANE,
 R1615 THE TRANSPONDER AXIS, OR THE AOT FOR THE LEM, THE PROGRAM WILL CORRECT THIS PROBLEM BY ROTATING THE CROSS-
 R1617 PRODUCT ATTITUDE ABOUT POINTVSM BY A FIXED AMOUNT SUFFICIENT TO ROTATE THE DESIRED S/C ATTITUDE OUT OF GIMBAL
 R1619 LOCK. IF THE AXIS TO BE POINTED IS MORE THAN 40.6 DEGREES BUT LESS THAN 60.5 DEG FROM THE +X (OR -X) AXIS,
 R1621 THE ADDITIONAL ROTATION TO AVOID GIMBAL LOCK IS 35 DEGREES. IF THE AXIS IS MORE THAN 60.5 DEGREES FROM +X (OR -X)
 R1623 THE ADDITIONAL ROTATION IS 35 DEGREES. THE GIMBAL ANGLES CORRESPONDING TO THIS ATTITUDE ARE THEN COMPUTED AND
 R1625 STORED AS 2S COMPLIMENT ANGLES IN TMPAC) BEFORE RETURNING TO THE CALLER.

R1627 WHEN POINTING THE X-AXIS, OR THE THRUST VECTOR, OR ANY VECTOR WITHIN 40.6 DEG OF THE X-AXIS, VECPOINT
 R1629 CANNOT CORRECT FOR A CROSS-PRODUCT ROTATION INTO GIMBAL LOCK. IN THIS CASE A PLATFORM REALIGNMENT WOULD BE
 R1631 REQUIRED TO POINT THE VECTOR IN THE DESIRED DIRECTION. AT PRESENT NO INDICATION IS GIVEN FOR THIS SITUATION
 R1633 EXCEPT THAT THE FINAL MIDDLE GIMBAL ANGLE IN MPAC +2 IS GREATER THAN 59 DEGREES.

R1635 CALLING SEQUENCE -

- R1636 1) LOAD SCAXIS, POINTVSM
 R1637 2) CALL

R1638 VECPOINT

R1639 RETURNS WITH

- R1640 1) DESIRED OUTER GIMBAL ANGLE IN MPAC
 R1641 2) DESIRED INNER GIMBAL ANGLE IN MPAC +1
 R1642 3) DESIRED MIDDLE GIMBAL ANGLE IN MPAC +2
 R1643 ERASABLES USED -

R1644	1) SCAXIS	6
R1645	2) POINTVSM	6
R1646	3) MIS	16
R1647	4) DEL	18
R1648	5) COP	6
R1649	6) VECOTEMP	1
R1650	7) ALL OF VAC AREA	43

R1651 TOTAL 99

1652 REF 1 27,2000
 1653 27,2126

SETLOC VECPT
 BANK

L R80,R82

USER=5 PAGE NO. 5 E2 S4

1654	REP	4	LAST	112	E6,1661	EBANK= BCDU		
1655	REP	1				COUNT	27/VECP	
1656					27,2126	40020 1	VECPPOINT STO	BOV
1657	REP	1			27,2127	03310 0		VECCTEMP
1658	REP	1			27,2130	56131 1		VECCLEAR
1659					27,2131	47164 1	VECCLEAR	AXC,2
1660	REP	2	LAST	112	27,2132	03320 0		MIS
1661	REP	1			27,2133	44376 0		READCDUK
1662					27,2134	34032 1	STCALL	25D
1663	REP	1			27,2135	44405 0		CDUTODCM
1664					27,2136	61375 1	VLOAD	VXM
1665	REP	2	LAST	112	27,2137	03357 0		POINTVSM
1666	REP	3	LAST	367	27,2140	03321 1		MIS
1667					27,2141	77656 1	UNIT	
1668					27,2142	00035 1	STORE	28D
A1669								
1670					27,2143	53435 0	VXV	UNIT
1671	REP	2	LAST	112	27,2144	03351 0		SCAXIS
1672					27,2145	57400 1	BOV	VCOMP
1673	REP	1			27,2146	56256 0		PICKAXIS
1674	REP	2	LAST	112	27,2147	17343 0	STODL	COF
1675					27,2150	00045 0		36D
1676					27,2151	50025 0	DSU	RMN
1677	REP	1			27,2152	16327 0		DPB-14
1678	REP	2	LAST	367	27,2153	56256 0		PICKAXIS
1679					27,2154	50375 0	VLOAD	DOT
1680	REP	3	LAST	367	27,2155	03351 0		SCAXIS
1681					27,2156	00035 1		28D
1682					27,2157	65552 0	SL1	ARCCOS
1683					27,2160	77624 1	COMPATX	CALL
1684	REP	1			27,2161	44530 1		DELCOMP
1685					27,2162	75160 1	AXC,1	AXC,2
1686	REP	4	LAST	367	27,2163	03320 0		MIS
1687	REP	1			27,2164	03425 1		DEL
1688					27,2165	77624 1	CALL	
1689	REP	1			27,2166	44304 0		MCM3
1690					27,2167	51545 1	DLOAD	ABS
1691					27,2170	00007 0		6
1692					27,2171	50025 0	DSU	RMN
1693	REP	1			27,2172	16314 0		SINGIMLC
1694	REP	1			27,2173	56246 1		FINDGIMB
A1695								
1696					27,2174	51545 1	DLOAD	ABS
1697	REP	4	LAST	367	27,2175	03351 0		SCAXIS
1698					27,2176	51025 1	DSU	RPL
1699	REP	1			27,2177	16316 1		SINVEC1

SAVE RETURN ADDRESS

AND CLEAR OVIND

READ THE PRESENT CDU ANGLES AND STORE THEM IN PD25, 26, 27

S/C AXES TO STABLE MEMBER AXES (MIS)

RESOLVE THE POINTING DIRECTION VF INTO INITIAL S/C AXES (VF = POINTVSM)

PD 26 29 30 31.32 33
TAKE THE CROSS PRODUCT VF X VI
WHERE VI = SCAXIS

CHECK MAGNITUDE
OF CROSS PRODUCT
VECTOR, IF LESS
THAN R-14 ASSUME
UNIT OPERATION
INVALID.

NOW COMPUTE THE TRANSFORMATION FROM
FINAL S/C AXES TO INITIAL S/C AXES MFI

COMPUTE THE TRANSFORMATION FROM FINAL
S/C AXES TO STABLE MEMBER AXES
MFS = MIS MFI
(IN PD LIST)

MFS6 = SIN(CPSI) \$2

= SIN(59 DEGS) \$2
/CPSI/ LESS THAN 59 DEGS
I.E. DESIRED ATTITUDE NOT IN GIMBAL LOCK

CHECK TO SEE IF WE ARE POINTING
THE THRUST AXIS

SIN 49.4 DEGS \$2



L R60,R62

USER=5 PAGE NO. 6 Pg 54

1700 REP 2 LAST 387 27,2200 56246 1 FINDGIMB
1701 27,2201 77775 1 VLOAD
1702 27,2202 77028 0 STADR
1703 REP 5 LAST 387 27,2203 50442 0 STOVL MIS +12D
1704 27,2204 77820 0 STADR
1705 REP 6 LAST 388 27,2205 50450 0 STOVL MIS +6
1708 27,2208 77828 0 STADR
1707 REP 7 LAST 388 27,2207 50458 0 STOVL MIS
1708 REP 8 LAST 388 27,2210 03327 1 MIS +6
1709 27,2211 57444 1 BPL VCOMP
1710 REP 1 27,2212 58213 1 IGSANEX IGSANEX

IF SO, WE ARE TRYING TO POINT IT INTO
GIMBAL LOCK, ABORT COULD GO HERE

STORE MFS (IN PD LIST) IN MIS

INNER GIMBAL AXIS IN FINAL S/C AXES
LOCATE THE IG AXIS DIRECTION CLOSEST TO
FINAL X S/C AXIS

1711 27,2213 50035 1 IGSANEX VXV RNW
1712 REP 5 LAST 387 27,2214 03351 0 SCAXIS
1713 REP 1 27,2215 58222 0 U=SCAXIS

FIND THE SHORTEST WAY OF ROTATING THE
S/C OUT OF GIMBAL LOCK BY A ROTATION
ABOUT +- SCAXIS, I.E. IF (IG (SGN MFS3)
X SCAXIS - XP) LESS THAN 0, U = SCAXIS
OTHERWISE U = -SCAXISA1714
A1715

1718 27,2218 57575 1 VLOAD VCOMP
1717 REP 8 LAST 388 27,2217 03351 0 SCAXIS
1718 REP 3 LAST 387 27,2220 37343 1 STCALL COP
1719 REP 1 27,2221 58225 1 CHEXAXIS
1720 27,2222 77775 1 U=SCAXIS VLOAD
1721 REP 7 LAST 388 27,2223 03351 0 SCAXIS
1722 REP 4 LAST 388 27,2224 03343 0 STORE COP
1723 27,2225 51545 1 CHEXAXIS DLOAD ABS
1724 REP 8 LAST 388 27,2226 03351 0 SCAXIS
1725 27,2227 51025 1 DSU BPL
1726 REP 1 27,2230 18320 1 SINVEC2
1727 REP 1 27,2231 58235 0 PICKANG1
1728 27,2232 52145 0 DLOAD GOTO
1729 REP 1 27,2233 18324 0 VECANG2
1730 REP 1 27,2234 58237 1 COMPMPN

ROTATE ABOUT -SCAXIS

ROTATE ABOUT + SCAXIS

SEE IF WE ARE POINTING THE AOT

SIN 29.5 DEGS \$2
IF SO, ROTATE 50 DEGS ABOUT +- SCAXIS
IF NOT, MUST BE POINTING THE TRANSPONDER
OR SOME VECTOR IN THE Y, OR Z PLANE
IN THIS CASE ROTATE 35 DEGS TO GET OUT
OF GIMBAL LOCK (VEANG2 \$360)

A1731
1732 27,2235 77745 1 PICKANG1 DLOAD
1733 REP 1 27,2236 18322 0 VECANG1
1734 27,2237 77624 1 COMPMPN CALL
1735 REP 2 LAST 387 27,2240 44530 1 DELCO-
1736 27,2241 75160 1 AXC,1 AXC,2
1737 REP 9 LAST 388 27,2242 03320 1 MIS
1738 REP 2 LAST 387 27,2243 03425 1 DEL
1739 27,2244 77624 1 CALL
1740 REP 2 LAST 387 27,2245 44304 0 MC43

= 50 DEGS \$ 380

COMPUTE THE ROTATION ABOUT SCAXIS TO
BRING MFS OUT OF GIMBAL LOCKCOMPUTE THE NEW TRANSFORMATION FROM
DESIRED S/C AXES TO STABLE MEMBER AXES
WHICH WILL ALIGN VI WITH VP AND AVOID
GIMBAL LOCK

A1741
A1742
1743 27,2248 45180 1 FINDGIMB AXC,1 CALL
1744 27,2247 00000 1 0
1745 REP 1 27,2250 44655 1 DCMTCOU
1748 27,2251 40234 0 RTB SETPD
1747 REP 1 27,2252 45547 0 VISTO2S

EXTRACT THE COMMANDED CDU ANGLES FROM
THIS MATRIX

CONVERT TO 2'S COMPLEMENT



L R60,R62

USER=3 PAGE NO. 7 E6 S4

1748				27,2253	00001 0		0		
1749				27,2254	77850 1		GOTO		
1750	REF	2	LAST	387	27,2255	03310 0		VECCQTEMP	RETURN TO CALLER
1751				27,2258	50375 0	PICKAXIS	VLOAD	DOT	IF VP X VI = 0, FIND VP . VI
1752				27,2257	00035 1			28D	
1753	REF	9	LAST	388	27,2260	03351 0		SCAXIS	
1754				27,2261	72240 1		BN	TLOAD	
1755	REF	1			27,2262	56268 0		ROT180	
1756				27,2263	00032 0			25D	
1757				27,2264	77850 1		GOTO		IF VP = VI, CDU DESIRED = PRESENT CDU
1758	REF	3	LAST	389	27,2265	03310 0		VECCQTEMP	PRESENT CDU ANGLES
1759				27,2266	47375 0	ROT180	VLOAD	VXV	IF VP, VI ANTIPARALLEL, 180 DEG ROTATION
1760	REF	10	LAST	388	27,2267	03327 1		MIS +6	IS REQUIRED. Y STABLE MEMBER AXIS IN
1761	REF	2	LAST	281	27,2270	15330 0		HIUNITX	INITIAL S/C AXIS.
1762				27,2271	47258 0		UNIT	VXV	FIND Y(SM) X X(I)
1763	REF	10	LAST	389	27,2272	03351 0		SCAXIS	FIND UNIT(VI X UNIT(Y(SM) X X(I)))
1764				27,2273	40058 0		UNIT	BOV	I.E. PICK A VECTOR IN THE PLANE OF X(I),
1765	REF	1			27,2274	56310 0		PICKX	Y(SM) PERPENDICULAR TO VI
1766	REF	5	LAST	388	27,2275	17343 0		STODL	
1767				27,2276	00045 0			36D	CHECK MAGNITUDE
1768				27,2277	50025 0		DSJ	BN	OF THIS VECTOR.
1769	REF	2	LAST	387	27,2300	16327 0		DPB-14	IF LESS THAN B-14,
1770	REF	2	LAST	389	27,2301	56310 0		PICKX	PICK X-AXIS.
1771				27,2302	77775 1		VLOAD		
1772	REF	6	LAST	389	27,2303	03343 0		COP	
1773	REF	7	LAST	389	27,2304	17343 0	XROT	STODL	COP
1774	REF	2	LAST	289	27,2305	15330 0		HIDPHALF	
1775				27,2306	77850 1		GOTO		
1776	REF	1			27,2307	56160 0		COMPMATX	
1777				27,2310	52175 0	PICKX	VLOAD	GOTO	PICK THE XAXIS IN THIS CASE
1778	REF	3	LAST	389	27,2311	15330 0		HIUNITX	
1779	REF	1			27,2312	56304 0		XROT	
1780				35,2000			BANK	35	
1781	REF	1			27,2000		SETLOC	MANUVER1	
1782				27,2313			BANK		
1783				27,2313	15555 0	SINGIMLC	2DEC	.4285836003	=SIN(59) \$2
1783				27,2314	35172 0				
1784				27,2315	14113 1	SINVEC1	2DEC	.3798358537	=SIN(49.4) \$2
1784				27,2316	36326 0				
1785				27,2317	07701 0	SINVEC2	2DEC	.2482117800	=SIN(29.5) \$2
1785				27,2320	35703 0				
1786				27,2321	04343 1	VECCANG1	2DEC	.1388888889	= 50 DEGREES \$360
1786				27,2322	21816 0				
1787				27,2323	03070 0	VECCANG2	2DEC	.0972222222	= 35 DEGREES \$360
1787				27,2324	34344 0				
1788				27,2325	00000 1	1BITDP	OCT	0	KEEP THIS BEFORE DPB(-14) *****
1789				27,2326	00001 0	DPB-14	OCT	00001	



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 20211111-041

20'35 OCT. 28,1968 KOOLADE .089 PAGE 390

L R60,R62

USER=3 PAGE NO. 8 E6 S4

1790		27,2327	00000 1	OCT	00000
1791		34,2002		BANK	34
1792	REF 2 LAST 383	27,2000		SETLOC	MANUVER
1793		27,2330		BANK	



L R60,R62

USER=8 PAGE NO. 9 E6 S4

P1794 ROUTINE FOR INITIATING AUTOMATIC MANEUVER VIA KEYBOARD (V49)

1795 REF 4 LAST 383 1155 EBANK= CPHI

1796 REF 1 COUNT 27/R62

1797 REF 1 27,2330 3 4745 0 R62DISP CAP V06N22

1798 REF 57 LAST 384 27,2331 0 4555 0 TC BANKCALL

1799 REF 2 LAST 190 27,2332 20824 0 CADR GCFASH

1800 REF 18 LAST 257 27,2333 1 5423 0 TCP ENDEXT

1801 REF 1 27,2334 1 2338 1 TCP GQMOVE

1802 REF 2 LAST 248 27,2335 1 2330 1 TCP R62DISP

A1803

A1804

1805 REF 15 LAST 384 27,2338 0 5435 0 GQMOVE TC UPFLAG

1806 REF 2 LAST 384 27,2337 00124 0 ADRES 3AXISFLG

1807 REF 58 LAST 391 27,2340 0 4555 0 TC BANKCALL

1808 REF 1 27,2341 58000 1 CADR R60CSM

1809 REF 17 LAST 391 27,2342 1 5423 0 TCP ENDEXT

DISPLAY COMMAND ICDUS CPHI, CTHETA, CPHI

PROCEED

ENTER

ASTRONAUT MAY LOAD NEW ICDUS AT THIS POINT

SET 3-AXIS FLAG

BIT 8 FLAG 5



L ANGLPIND

USER'S PAGE NO. 1 E0 S4

0500				15,2000				BANK 15		
050001	REP	1		22,2000				SETLOC KALOMAN1		
050002				22,2000				BANK		
0501	REP	5	LAST	387	E6,1861			EBANK= BCDU		
05015	REP	1						COUNT 22/KALC		
0502	REP	11	LAST	383	22,2000	0 6006 1	KALOMAN3	TC	INTPRET	
0503					22,2001	77634 0		RTB		
0504	REP	2	LAST	387	22,2002	44378 0			READCDLK	PICK UP CURRENT CDU ANGLES
0505	REP	6	LAST	392	22,2003	03262 1		STORE	BCDU	STORE THE INITIAL S/C ANGLES
0516					22,2004	72364 0		AXC,2	TLOAD	COMPUTE THE TRANSFORMATION FROM
0517	REP	11	LAST	389	22,2005	03320 0			MIS	INITIAL S/C AXES TO STABLE MEMBER AXES
0518	REP	7	LAST	392	22,2006	03262 1			BCDU	(MIS)
0519					22,2007	77624 1		CALL		
0520	REP	2	LAST	387	22,2010	44405 0			CDUTODCM	
0521					22,2011	72364 0		AXC,2	TLOAD	COMPUTE THE TRANSFORMATION FROM
0522	REP	4	LAST	119	22,2012	03425 1			MPS	FINAL S/C AXES TO STABLE MEMBER AXES
0523	REP	5	LAST	391	22,2013	01156 1			CPHI	(MPS)
0524					22,2014	77624 1		CALL		
0525	REP	3	LAST	392	22,2015	44405 0			CDUTODCM	
0526					22,2016	45160 1	SECAD	AXC,1	CALL	MIS AND MPS ARRAYS CALCULATED
0527	REP	12	LAST	392	22,2017	03320 0			MIS	\$2
0528	REP	1			22,2020	44334 0			TRANSPOS	
0529					22,2021	77775 1		VLOAD		
0530					22,2022	77626 0		STADR		
0531	REP	12	LAST	112	22,2023	50474 0		STOVL	TMIS +12D	
0532					22,2024	77626 0		STADR		
0533	REP	13	LAST	392	22,2025	50502 0		STOVL	TMIS +6	
0534					22,2026	77626 0		STADR		
0535	REP	14	LAST	392	22,2027	74510 0		STORE	TMIS	TMIS = TRANSPOSE(MIS) SCALED BY 2
0536					22,2030	75160 1		AXC,1	AXC,2	
0537	REP	15	LAST	392	22,2031	03266 0			TMIS	
0538	REP	5	LAST	392	22,2032	03425 1			MPS	
0539					22,2033	77624 1		CALL		
0540	REP	3	LAST	388	22,2034	44304 0			MCM3	
0541					22,2035	45575 1		VLOAD	STADR	
0542	REP	1			22,2036	50335 1		STOVL	MPI +12D	
0543					22,2037	77626 0		STADR		
0544	REP	2	LAST	392	22,2040	50343 0		STOVL	MPI +6	
0545					22,2041	77626 0		STADR		
0546	REP	3	LAST	392	22,2042	74351 0		STORE	MPI	MPI = TMIS MPS (SCALED BY 4)
0547					22,2043	45001 1		SETPD	CALL	TRANSPOSE MPI IN PD LIST
0548					22,2044	00023 0			18D	
0549	REP	1			22,2045	44343 0			TRNSPSPD	
0550					22,2046	45575 1		VLOAD	STADR	
0551	REP	1			22,2047	50474 0		STOVL	TMPI +12D	
0552					22,2050	77626 0		STADR		
0553	REP	2	LAST	392	22,2051	50502 0		STOVL	TMPI +6	



L ANGLFIND

USER'S PAGE NO. 2 E6 S4

0554
0555 REF 3 LAST 392 22,2052 77626 0
R0558 22,2053 74510 0

STADR
STORE TMPI

TMPI = TRANSPOSE (MPI) SCALED BY 4

R0557 CALCULATE COFSKEW AND MPISYM

R0556
0559 22,2054 45345 1
0560 REF 4 LAST 393 22,2055 03271 0
0561 REF 4 LAST 392 22,2056 03430 0
0562 22,2057 45325 1
0563 REF 5 LAST 393 22,2060 03432 1
0564 REF 5 LAST 393 22,2061 03273 1
0565 22,2062 45325 1
0566 REF 6 LAST 393 22,2063 03301 0
0567 REF 6 LAST 393 22,2064 03440 1
0568 22,2065 77666 1
0569 REF 4 LAST 112 22,2066 03311 1

DLOAD DSU
TMPI +2
MPI +2
POOL DSU
MPI +4
TMPI +4
POOL DSU
TMPI +10D
MPI +10D
VDEF
STORE COFSKEW

CALCULATE COP SCALED BY 2/SIN(AM)

EQUALS MPISKEW

R0570
R0571 CALCULATE AM AND PROCEED ACCORDING TO ITS MAGNITUDE
R0572

0573 22,2067 43345 1
0574 REF 7 LAST 393 22,2070 03426 1
0575 REF 6 LAST 393 22,2071 03446 1
0576 22,2072 43225 0
0577 REF 2 LAST 31 22,2073 15322 0
0578 REF 9 LAST 393 22,2074 03438 0
0579 REF 3 LAST 112 22,2075 03317 1
0580 22,2076 77728 1
0581 REF 2 LAST 112 22,2077 03385 1
0582 22,2100 51025 1
0583 REF 1 22,2101 04367 1
0584 REF 1 22,2102 44111 0
0585 22,2103 77778 1
0586 22,2104 0 0004 0
0587 REF 51 LAST 381 22,2105 4 4712 0
0588 REF 1 22,2108 55*332 0
0589 REF 1 22,2107 0 3301 0
0590 REF 1 22,2110 1 2727 0

DLOAD DAD
MPI
MPI +16D
DSU DAD
DP1/4TH
MPI +8D
STORE CAM
ARCCOS
STORE AM
DSU BPL
MINANG
CHECKMAX
EXIT
INHINT
CS ONE
TS HOLDFLAG
TC LOADCUD
TCP NOGO

CAM = (MPI0+MPI4+MPI8-1)/2 HALF SCALE

AM=ARCCOS(CAM) (AM SCALED BY 2)

MANEUVER LESS THAN 0.25 DEG
GO DIRECTLY INTO ATTITUDE HOLD
ABOUT COMMANDED ANGLES
NOGO WILL STOP ANY RATE AND SET UP FOR A
GOOD RETURN

0597 22,2111 45345 1
0598 REF 3 LAST 393 22,2112 03365 1
0599 REF 1 22,2113 04370 1
0600 22,2114 77244 0
0601 REF 1 22,2115 44123 1
0602 REF 5 LAST 393 22,2116 03311 1
0603 22,2117 77656 1
0604 REF 6 LAST 369 22,2120 03343 0
0605 22,2121 77650 1
0606 REF 1 22,2122 44736 0
0607 22,2123 53375 0
0608 REF 10 LAST 393 22,2124 03426 1

CHECKMAX DLOAD DSU
AM
MAXANG
BPL VLOAD
ALTCALC
COFSKEW
UNIT
STORE COP
GOTO
LOCSKIRT
ALTCALC VLOAD
VAD
MPI

UNIT
COFSKEW

COP IS THE MANEUVER AXIS
SEE IF MANEUVER GOES THRU GIMBAL LOCK

IF AM GREATER THAN 170 DEGREES



L ANGLPIND

USER=3 PAGE NO. 3 E6 S4

```
0609 REP 7 LAST 393 22,2125 03267 1      TMPI
0610      22,2126 77762 1      VSR1
0611 REP 1      22,2127 27287 1      STOV L MPISYM
0612 REP 11 LAST 393 22,2130 03434 1      MPI +6
0613      22,2131 74455 0      VAD VSR1
0614 REP 6 LAST 394 22,2132 03275 1      TMPI +6
0615 REP 2 LAST 394 22,2133 27275 1      STOV L MPISYM +6
0616 REP 12 LAST 394 22,2134 03442 0      MPI +12D
0617      22,2135 74455 0      VAD VSR1
0618 REP 9 LAST 394 22,2136 03303 1      TMPI +12D
0619 REP 3 LAST 394 22,2137 03303 1      STORE MPISYM +12D      MPISYM=(MPI+TMPI)/2 SCALED BY 4
R0620
R0621
R0622 CALCULATE COP
R0623
0624      22,2140 70545 1      DLOAD SR1
0625 REP 4 LAST 393 22,2141 03317 1      CAM
0626      22,2142 45325 1      POOL DSU      PD0 CAM      $4
0627 REP 1      22,2143 15330 0      DPHALP
0628 REP 5 LAST 394 22,2144 03317 1      CAM
0629      22,2145 65204 1      BOVB POOL      PD2 1 - CAM      $2
0630 REP 1      22,2146 45707 0      SIGNMPAC
0631 REP 4 LAST 394 22,2147 03307 0      MPISYM +16D
0632      22,2150 56225 1      DSU DDV
0633      22,2151 00001 0      0
0634      22,2152 00003 1      2
0635      22,2153 65366 1      SORT POOL      COPZ = SORT(MPISYM8-CAM)/(1-CAM) $ ROOT 2
0636 REP 5 LAST 394 22,2154 03277 0      MPISYM +8D
0637      22,2155 56225 1      DSU DDV
0638      22,2156 00001 0      0
0639      22,2157 00003 1      2
0640      22,2160 65366 1      SORT POOL      COPY = SORT(MPISYM4-CAM)/(1-CAM) $ROOT2
0641 REP 6 LAST 394 22,2161 03267 1      DSU MPISYM
0642      22,2162 56225 1      DSU DDV
0643      22,2163 00001 0      0
0644      22,2164 00003 1      2
0645      22,2165 55566 1      SORT VDEF      COFX = SORT(MPISYM-CAM)/(1-CAM) $ROOT 2
0646      22,2166 77656 1      UNIT
0647 REP 9 LAST 393 22,2167 03343 0      STORE COP
R0648
R0649 DETERMINE LARGEST COP AND ADJUST ACCORDINGLY
R0650
0651      22,2170 45345 1      CORMAXGO DLOAD DSU
0652 REP 10 LAST 394 22,2171 03343 0      COP
0653 REP 11 LAST 394 22,2172 03345 0      COP +2
0654      22,2173 71240 1      RVN DLOAD      COPY G COFX
0655 REP 1      22,2174 44203 0      COMP12
0656 REP 12 LAST 394 22,2175 03343 0      COP
0657      22,2176 50025 0      DSU RVN
0658 REP 13 LAST 394 22,2177 03347 1      COP +4
```



L ANGLFIND

USER'S PAGE NO. 4 E6 S4

0659	REP	1		22,2200	44280 0		METHOD3	COFZ G COFX OR COFY
0660				22,2201	77850 1	GOTO		
0661	REP	1		22,2202	44234 1		METHOD1	COFX G COFY OR COFZ
0662				22,2203	45345 1	COMP12 DLOAD	DSU	
0663	REP	14	LAST	394	22,2204	03345 0	COF +2	
0664	REP	15	LAST	395	22,2205	03347 1	COF +4	
0665				22,2208	77840 0	RNN		
0666	REP	2	LAST	395	22,2207	44260 0	METHOD3	COFZ G COFY OR COFX
0667				22,2210	51145 0	METHOD2 DLOAD	BPL	COFY MAX
0668	REP	6	LAST	393	22,2211	03313 0	COFSKEW +2	UY
0669	REP	1		22,2212	44216 1		U2POS	
0670				22,2213	57575 1	VLOAD	VCOMP	
0671	REP	16	LAST	395	22,2214	03343 0	COF	
0672	REP	17	LAST	395	22,2215	03343 0	STORE COF	
0673				22,2218	51145 0	U2POS DLOAD	BPL	
0674	REP	7	LAST	394	22,2217	03271 0	MPISYM +2	UX UY
0675	REP	1		22,2220	44224 0		OKU21	
0676				22,2221	57545 1	DLOAD	DCOMP	SIGN OF UX OPPOSITE TO UY
0677	REP	18	LAST	395	22,2222	03343 0	COF	
0678	REP	19	LAST	395	22,2223	03343 0	STORE COF	
0679				22,2224	51145 0	OKU21 DLOAD	BPL	
0680	REP	8	LAST	395	22,2225	03301 0	MPISYM +10D	UY UZ
0681	REP	2	LAST	393	22,2226	44736 0	LOCSKIRT	
0682				22,2227	57545 1	DLOAD	DCOMP	SIGN OF UZ OPPOSITE TO UY
0683	REP	20	LAST	395	22,2230	03347 1	COF +4	
0684	REP	21	LAST	395	22,2231	03347 1	STORE COF +4	
0685				22,2232	77850 1	GOTO		
0686	REP	3	LAST	395	22,2233	44736 0	LOCSKIRT	
0687				22,2234	51145 0	METHOD1 DLOAD	BPL	COFX MAX
0688	REP	7	LAST	395	22,2235	03311 1	COFSKEW	UX
0689	REP	1		22,2236	44242 0		U1POS	
0690				22,2237	57575 1	VLOAD	VCOMP	
0691	REP	22	LAST	395	22,2240	03343 0	COF	
0692	REP	23	LAST	395	22,2241	03343 0	STORE COF	
0693				22,2242	51145 0	U1POS DLOAD	BPL	
0694	REP	9	LAST	395	22,2243	03271 0	MPISYM +2	UX UY
0695	REP	1		22,2244	44250 0		OKU12	
0696				22,2245	57545 1	DLOAD	DCOMP	
0697	REP	24	LAST	395	22,2246	03345 0	COF +2	SIGN OF UY OPPOSITE TO UX
0698	REP	25	LAST	395	22,2247	03345 0	STORE COF +2	
0699				22,2250	51145 0	OKU12 DLOAD	BPL	
0700	REP	10	LAST	395	22,2251	03273 1	MPISYM +4	UX UZ
0701	REP	4	LAST	395	22,2252	44736 0	LOCSKIRT	
0702				22,2253	57545 1	DLOAD	DCOMP	SIGN OF UZ OPPOSITE TO UY
0703	REP	26	LAST	395	22,2254	03347 1	COF +4	
0704	REP	27	LAST	395	22,2255	03347 1	STORE COF +4	
0705				22,2256	77650 1	GOTO		
0706	REP	5	LAST	395	22,2257	44736 0	LOCSKIRT	
0707				22,2260	51145 0	METHOD3 DLOAD	BPL	COFZ MAX



L ANGLPIND

USER'S PAGE NO. 5 E8 S4

0708	REF	8	LAST	395	22,2261	03315 0		COPSCW +4	UZ
0709	REF	1			22,2262	44266 0		U3POS	
0710					22,2263	57575 1		VLOAD	VCOMP
0711	REF	28	LAST	395	22,2264	03343 0		COP	
0712	REF	29	LAST	396	22,2265	03343 0		STORE	COP
0713					22,2266	51145 0	U3POS	DLOAD	BPL
0714	REF	11	LAST	395	22,2267	03273 1		MFISYM +4	UX UZ
0715	REF	1			22,2270	44274 0		OKU31	
0716					22,2271	57545 1		DLOAD	DCOMP
0717	REF	30	LAST	396	22,2272	03343 0		COP	
0718	REF	31	LAST	396	22,2273	03343 0		STORE	COP
0719					22,2274	51145 0	OKU31	DLOAD	BPL
0720	REF	12	LAST	396	22,2275	03301 0		MFISYM +10D	UY UZ
0721	REF	6	LAST	395	22,2276	44736 0		LOCSKIRT	
0722					22,2277	57545 1		DLOAD	DCOMP
0723	REF	32	LAST	396	22,2300	03345 0		COP +2	
0724	REF	33	LAST	396	22,2301	03345 0		STORE	COP +2
0725					22,2302	77650 1		GOTO	
0726	REF	7	LAST	396	22,2303	44736 0		LOCSKIRT	



L ANCLPIND

USER'S PAGE NO. 6 E6 S4

```
R0727
R0728 MATRIX OPERATIONS
R0729
0730      22,2304 77601 0 MM3 SETPD      MM3 MULTIPLIES 2 3X3 MATRICES
0731      22,2305 00001 0          0      AND LEAVES RESULT IN PD LIST
0732      22,2306 64743 0          DLOAD* PDDL* ADDRESS OF 1ST MATRIX IN XR1
0733      22,2307 77762 1          12D,2  ADDRESS OF 2ND MATRIX IN XR2
0734      22,2310 77770 1          6,2
0735      22,2311 55523 0          PDDL* VDEF  DEFINE VECTOR M2(COL 1)
0736      22,2312 77776 1          0,2
0737      22,2313 64717 1          MMV* PDDL*  MIXM2(COL 1) IN PD
0738      22,2314 00001 0          0,1
0739      22,2315 77760 0          14D,2
0740      22,2316 64723 0          PDDL* PDDL*
0741      22,2317 77766 0          8D,2
0742      22,2320 77774 0          2,2
0743      22,2321 63666 1          VDEF MMV*  DEFINE VECTOR M2(COL 2)
0744      22,2322 00001 0          0,1
0745      22,2323 64723 0          PDDL* PDDL*  MIXM2(COL 2) IN PD
0746      22,2324 77756 0          18D,2
0747      22,2325 77764 1          10D,2
0748      22,2326 55523 0          PDDL* VDEF  DEFINE VECTOR M2(COL 3)
0749      22,2327 77772 0          4,2
0750      22,2330 41517 1          MMV* PUSH  MIXM2(COL 3) IN PD
0751      22,2331 00001 0          0,1
0752      22,2332 77650 1          GOTO
0753      22,2333 44343 0          TRNSPSPD REVERSE ROWS AND COLS IN PD AND
R0754      REF 2 LAST 392      RETURN WITH MIXM2 IN PD LIST
R0755
0756      22,2334 76601 1 TRANSPOS SETPD VLOAD* TRANSPOS TRANSPOSES A 3X3 MATRIX
0757      22,2335 00001 0          0      AND LEAVES RESULT IN PD LIST
0758      22,2336 00001 0          0,1  MATRIX ADDRESS IN XR1
0759      22,2337 62713 0          PDVL* PDVL*
0760      22,2340 00007 0          6,1
0761      22,2341 00015 0          12D,1
0762      22,2342 77606 1          PUSH
0763      22,2343 65345 0 TRNSPSPD DLOAD PDDL  MATRIX IN PD
0764      22,2344 00003 1          2      ENTER WITH MATRIX IN PD LIST
0765      22,2345 00007 0          6
0766      22,2346 14003 1          STODL 2
0767      22,2347 77626 0          STADR
0768      22,2350 63770 1          STODL 6
0769      22,2351 00005 1          4
0770      22,2352 77725 1          PDDL
0771      22,2353 00015 0          12D
0772      22,2354 14005 1          STODL 4
0773      22,2355 77626 0          STADR
0774      22,2356 63762 1          STODL 12D
0775      22,2357 00013 0          10D
0776      22,2360 77725 1          PDDL
```



L ANGLPIND

USER=S PAGE NO. 7 E6 S4

```
0777      22,2381  00017 1      14D
0778      22,2382  14013 0      STODL 10D
0779      22,2383  77828 0      STADR
0780      22,2384  77780 0      STORE 14D
0781      22,2385  77818 0      RVQ
0782      22,2388  00013 0 MINANG DEC .00089375
0783      22,2387  17071 1 MAXANG DEC .472222
R0784      GIMBAL LOCK CONSTANTS
```

RETURN WITH TRANSPOSED MATRIX IN PD LIST

```
R0785      D = MGA CORRESPONDING TO GIMBAL LOCK = 80 DEGREES
R0786      NGL = BUFFER ANGLE (TO AVOID DIVISIONS BY ZERO) = 2 DEGREES
```

```
0787      22,2370  15887 1 SD      DEC .433015
0788      22,2371  33555 1 K351    DEC .88803
0789      22,2372  87777 1 K4      DEC -.25
0790      22,2373  04000 0 K4SQ    DEC .125
0791      22,2374  00217 0 SNGLCD  DEC .008725
0792      22,2375  17773 1 CNGL    DEC .499895
0794      22,2378  0 0004 0 READCDK INHINT
0795      REF 5 LAST 238 22,2377  3 0034 0 CA      CDUZ
0798      REF 217 LAST 384 22,2400  54 156 1 TS      MPAC +2
0797      22,2401  0 0008 1 EXTEND
0798      REF 6 LAST 288 22,2402  3 0033 1 DCA      CDUX
0799      22,2403  0 0003 1 RELINT
0800      REF 1      22,2404  1 8445 0 TCF      TLOAD +8
0801      18,2000      BANK      18
080101 REF 1      22,2000      SETLOC KALOMON2
080102      22,2405      BANK
```

```
= SIN(D)          $2
= SIN(D)          $1
= - COS(D)        $2
= COS(D)COS(D)    $2
= SIN(NGL)COS(D)  $2
= COS(NGL)        $2
LOAD T(MPAC) WITH THE CURRENT CDU ANGLES
```

```
080105 REF 2 LAST 392 TO 398' 281 281* COUNT* $$/KALC
```

```
0802      22,2405  88370 0 CDUTODCM AXT,1 SSP
0803      22,2408  00003 1 OCT      3
0804      REF 1      22,2407  00051 0 S1
0805      22,2410  00001 0 OCT      1
0808      22,2411  00010 0 STORE 7
0807      22,2412  77801 0 SETPD
0808      22,2413  00001 0
0809      22,2414  47133 0 LOOPSIN SLOAD* RTB
0810      22,2415  00013 0 10D,1
0811      REF 3 LAST 280 22,2418  45510 1 CDULOGIC
0812      22,2417  00013 0 STORE 10D
0813      22,2420  65356 1 SIN      PDOL
0814      22,2421  00013 0 10D
0815      22,2422  41548 0 COS      PUSH
0818      22,2423  71300 1 TIX,1  DLOAD
0817      REF 1      22,2424  44414 0 LOOPSIN
0818      22,2425  00007 0 8
0819      22,2428  72405 0 DMP      SL1
0820      22,2427  00013 0 10D
```

```
SUBROUTINE TO COMPUTE DIRECTION COSINE
MATRIX RELATING S/C AXES TO STABLE
MEMBER AXES FROM 3 CDU ANGLE5 IN T(MPAC)
SET XR1, S1 AND PD FOR LOOP
```

```
LOAD PD WITH 0 SIN(PHI)
              2 COS(PHI)
              4 SIN(THETA)
              8 COS(THETA)
              8 SIN(PSI)
             10 COS(PSI)
```




L ANGLPIND

USER=3 PAGE NO. 8 E6 S4

0821	22,2430	10001 1	STORE	0,2	
0822	22,2431	77745 1	DLOAD		
0823	22,2432	00005 1		4	
0824	22,2433	65205 0	DMP	PDDL	
0825	22,2434	00001 0		0	(PD6 SIN(THETA)SIN(PHI))
0828	22,2435	00007 0		6	
0827	22,2438	41205 0	DMP	DMP	
0828	22,2437	00011 1		8D	
0829	22,2440	00003 1		2	
0830	22,2441	44352 0	SL1	EDSU	
0831	22,2442	00015 0		12D	
0832	22,2443	77752 1	SL1		
0833	22,2444	10003 0	STORE	2,2	
0834	22,2445	77745 1	DLOAD		
0835	22,2446	00003 1		2	
0838	22,2447	65205 0	DMP	PDDL	(PD7 COS(PHI)SIN(THETA)) SCALED 4
0837	22,2450	00005 1		4	
0838	22,2451	00007 0		6	
0839	22,2452	41205 0	DMP	DMP	
0840	22,2453	00011 1		8D	
0841	22,2454	00001 0		0	
0842	22,2455	77752 1	SL1		
0843	22,2456	72415 1	DAD	SL1	
0844	22,2457	00017 1		14D	
0845	22,2460	10005 0	STORE	4,2	
0848	22,2481	77745 1	DLOAD		
0847	22,2462	00011 1		8D	
0848	22,2463	10007 1	STORE	8,2	
0849	22,2464	77745 1	DLOAD		
0850	22,2465	00013 0		10D	
0851	22,2466	72405 0	DMP	SL1	
0852	22,2467	00003 1		2	
0853	22,2470	10011 0	STORE	8D,2	
0854	22,2471	77745 1	DLOAD		
0855	22,2472	00013 0		10D	
0858	22,2473	57405 1	DMP	DCOMP	
0857	22,2474	00001 0		0	
0858	22,2475	77752 1	SL1		
0859	22,2478	10013 1	STORE	10D,2	
0860	22,2477	77745 1	DLOAD		
0881	22,2500	00005 1		4	
0882	22,2501	57405 1	DMP	DCOMP	
0883	22,2502	00013 0		10D	
0884	22,2503	77752 1	SL1		
0885	22,2504	10015 1	STORE	12D,2	
0888	22,2505	77745 1	DLOAD		
0887	22,2506	72405 0	DMP	SL1	(PUSH UP 7)
0888	22,2507	00011 1		8D	
0889	22,2510	41325 0	PDDL	DMP	(PD7 COS(PHI)SIN(THETA)SIN(PHI)) SCALE4
0870	22,2511	00007 0		8	



L ANGLPIND

USER=5 PAGE NO. 9 Pg 84

0871	22,2512	00001 0		0	
0872	22,2513	72415 1	DAD	SL1	(PUSH UP 7)
0873	22,2514	77626 0	STADR		$C7 = \cos(\Phi) \sin(\Theta) \sin(\Psi)$
0874	22,2515	67780 1	STORE	14D,2	
0875	22,2516	77745 1	DLOAD		
0876	22,2517	72405 0	DMP	SL1	(PUSH UP 8)
0877	22,2520	00011 1		8D	
0878	22,2521	41325 0	PDDL	DMP	$(PD6 \sin(\Theta) \sin(\Phi) \sin(\Psi)) \text{ SCALE4}$
0879	22,2522	00007 0		6	
0880	22,2523	00003 1		2	
0881	22,2524	72425 1	DSJ	SL1	(PUSH UP 8)
0882	22,2525	77626 0	STADR		
0883	22,2526	67756 1	STORE	16D,2	$C8 = -\sin(\Theta) \sin(\Phi) \sin(\Psi)$
0884	22,2527	77616 0	RVO		$+ \cos(\Theta) \cos(\Phi)$
0885	22,2530		ENDCOM	EQUALS	
0886	15,2000		BANK	15	
088801	REF 2 LAST 392	22,2000	SETLOC	KALCOM1	
088602	22,2530		BANK		

R0887 CALCULATION OF THE MATRIX DEL.....

R0888	*	*	--T	*	
R0889	$DEL = (IDMATRIX) \cos(A) + U(1 - \cos(A)) + UX \sin(A)$				SCALED 1

R0890
R0891 WHERE U IS A UNIT VECTOR (DP SCALED 2) ALONG THE AXIS OF ROTATION.
R0893 A IS THE ANGLE OF ROTATION (DP SCALED 2)
R0894
R0895 UPON ENTRY THE STARTING ADDRESS OF U IS COP, AND A IS IN MPAC

08955	REF 3 LAST 398 TO 400	83 344*	COUNT 22/KALC		
0896	22,2530	41401 1	DELCOMP	SETPD PUSH	MPAC CONTAINS THE ANGLE A
0897	22,2531	00001 0		0	
0898	22,2532	65356 1	SIN	PDDL	$PD0 = \sin(A)$
0899	22,2533	41546 0	COS	PUSH	$PD2 = \cos(A)$
08995	22,2534	85302 0	SR2	PDDL	$PD2 = \cos(A)$
0900	22,2535	41021 1	BDSJ	BOVB	$PD4 = 1 - \cos(A)$
0901	REF 2 LAST 394	22,2536		DPHALF	
09014	REF 2 LAST 394	22,2537		SIGNMPAC	

R0902 COMPUTE THE DIAGONAL COMPONENTS OF DEL

09024	22,2540	77725 1	PDDL		
0903	REF 34 LAST 396	22,2541	03343 0	COP	
0904	22,2542	41316 0	DSQ	DMP	
0905	22,2543	00005 1		4	
0906	22,2544	52415 0	DAD	SL3	



L ANGLFIND

USER'S PAGE NO. 10

E6 S4

0907 22,2545 00003 1
0908 22,2546 77604 0
0909 REF 3 LAST 400 22,2547 45707 0
0910 REF 3 LAST 366 22,2550 17426 1
0911 REF 35 LAST 400 22,2551 03345 0
0912 22,2552 41316 0
0913 22,2553 00005 1
0914 22,2554 52415 0
0915 22,2555 00003 1
0916 22,2556 77604 0
0917 REF 4 LAST 401 22,2557 45707 0
0918 REF 4 LAST 401 22,2560 17436 0
0919 REF 36 LAST 401 22,2561 03347 1
0920 22,2562 41316 0
0921 22,2563 00005 1
0922 22,2564 52415 0
0923 22,2565 00003 1
0924 22,2566 77604 0
0925 REF 5 LAST 401 22,2567 45707 0
0926 REF 5 LAST 401 22,2570 03446 1

2
BOVB SIGNMPAC
STOOL DEL UX UX(U-COS(A)) +COS(A) \$1
COP +2
DSQ DMP
4
DAD SL3
2
BOVB SIGNMPAC
STOOL DEL +8D UY UY(1-COS(A)) +COS(A) \$1
COP +4
DSQ DMP
4
DAD SL3
2
BOVB SIGNMPAC
STORE DEL +16D UZ UZ(1-COS(A)) +COS(A) \$1

R0927 COMPUTE THE OFF DIAGONAL TERMS OF DEL

0926 22,2571 41345 0
0929 REF 37 LAST 401 22,2572 03343 0
0930 REF 38 LAST 401 22,2573 03345 0
0931 22,2574 72405 0
0932 22,2575 00005 1
0933 22,2576 41325 0
0934 REF 39 LAST 401 22,2577 03347 1
0935 22,2600 00001 0
0936 22,2601 43206 1
0937 22,2602 00007 0
0938 22,2603 41112 0
0939 REF 6 LAST 401 22,2604 45707 0
0940 REF 6 LAST 401 22,2605 17434 1
0941 22,2606 62421 1
0942 22,2607 77604 0
0943 REF 7 LAST 401 22,2610 45707 0
0944 REF 7 LAST 401 22,2611 17430 0
0945 REF 40 LAST 401 22,2612 03343 0
0946 22,2613 41205 0
0947 REF 41 LAST 401 22,2614 03347 1
0948 22,2615 00005 1
0949 22,2616 65352 0
0950 REF 42 LAST 401 22,2617 03345 0
0951 22,2620 41405 0
0952 22,2621 00001 0
0953 22,2622 62415 0
0954 22,2623 00007 0

DLOAD DMP
COP
COP +2
DMP SL1
4
PDDL DMP D6 UX UY (1-COS A) \$ 4
COP +4
0
PUSH DAD D8 UZ SIN A \$ 4
6
SL2 BOVB
SIGNMPAC
STOOL DEL +6
BDSJ SL2
BOVB
SIGNMPAC
STOOL DEL +2
COP
DMP DMP
COP +4
4
SL1 PDDL D6 UX UZ (1-COS A) \$ 4
COP +2
DMP PUSH D8 UY SIN(A)
0
DAD SL2
6

L ANGLPIND

USER=S PAGE NO. 11 E6 S4

```

0955
0956 REF 8 LAST 401 22,2624 77804 0 BOVB
0957 REF 8 LAST 401 22,2625 45707 0 SIGNMPAC
0958 22,2626 17432 1 STODL DEL +4 UX UZ (1-COS(A))+UY SIN(A)
0959 22,2627 62421 1 BDSU SL2
0960 REF 9 LAST 402 22,2630 77804 0 BOVB
0961 REF 9 LAST 402 22,2631 45707 0 SIGNMPAC
0962 REF 43 LAST 401 22,2632 17442 0 STODL DEL +12D UX UZ (U-COS(A))-UY SIN(A)
0963 22,2633 03345 0 COP +2
0964 REF 44 LAST 402 22,2634 41205 0 DMP DMP
0965 22,2635 03347 1 COP +4
0966 22,2636 00005 1 4
0967 REF 45 LAST 402 22,2637 85352 0 SL1 PDDL D6 UY UZ (1-COS(A)) S 4
0968 22,2640 03343 0 COP
0969 22,2841 41405 0 DMP PUSH D6 UX SIN(A)
0970 22,2642 00001 0 0
0971 22,2643 82415 0 DAD SL2
0972 22,2644 00007 0 6
0973 REF 10 LAST 402 22,2645 77804 0 BOVB
0974 REF 10 LAST 402 22,2646 45707 0 SIGNMPAC
0975 22,2647 17444 0 STODL DEL +14D UX UZ(1-COS(A)) +UX SIN(A)
0976 22,2650 82421 1 BDSU SL2
0977 REF 11 LAST 402 22,2651 77804 0 BOVB
0978 REF 11 LAST 402 22,2652 45707 0 SIGNMPAC
0979 22,2653 03440 1 STORE DEL +10D UX UZ (1-COS(A)) -UX SIN(A)
0980 22,2654 77818 0 RVO
R0980 DIRECTION COSINE MATRIX TO CDU ANGLE ROUTINE
R0981 X1 CONTAINS THE COMPLEMENT OF THE STARTING ADDRESS FOR MATRIX (SCALED 2)
R0982 LEAVES CDU ANGLES SCALED 2PI IN V(MPAC)
R0983 COS(MGA) WILL BE LEFT IN S1 (SCALED 1)

```

R0984 THE DIRECTION COSINE MATRIX RELATING S/C AXES TO STABLE MEMBER AXES CAN BE WRITTEN AS***

```

R0988 C =COS(THETA)COS(PHI)
R0987 0
R0988 C =-COS(THETA)SIN(PHI)COS(PHI)+SI (THETA)SIN(PHI)
R0989 1
R0990 C =COS(THETA)SIN(PHI)SIN(PHI) + S N(THETA)COS(PHI)
R0991 2
R0992 C =SIN(PHI)
R0993 3
R0994 C =COS(PHI)COS(PHI)
R0995 4
R0996 C =-COS(PHI)SIN(PHI)
R0997 5
R0998 C =-SIN(THETA)COS(PHI)
R0999 6
R1000 C =SIN(THETA)SIN(PHI)COS(PHI)+COS THETA)SIN(PHI)
R1001 7

```



L ANGLPIND

USER=3 PAGE NO. 12 E6 S4

R1002 C = -SIN(THETA)SIN(PSI)SIN(PHI)+CO (THETA)COS(PHI)
R1003 8

R1004 WHERE PHI = QCA
R1005 THETA = ICA
R1006 PSI = MCA

1007				22,2655	87543 1	DOMTODU DLOAD*	ARCSIN	
1008				22,2656	00007 0		6,1	
1009				22,2657	71406 0	PUSH	COS	PD +0 PSI
1010				22,2660	41152 1	SL1	BOVB	
1011	REF	12	LAST	402	22,2661	45707 0	SIGNMPAC	
1012	REF	2	LAST	398	22,2662	00051 0	STORE S1	
1013				22,2663	57543 1	DLOAD*	DCOMP	
1014				22,2664	00015 0		12D,1	
1015				22,2665	87471 1	DOV	ARCSIN	
1016	REF	3	LAST	403	22,2666	00051 0	S1	
1017				22,2667	51123 0	PDDL*	BPL	PD +2 THETA
1018				22,2670	00001 0		0,1	MUST CHECK THE SIGN OF COS(THETA)
1019	REF	1		22,2671	44703 0		QKTHETA	TO DETERMINE THE PROPER QUADRANT
1020				22,2672	57545 1	DLOAD	DCOMP	
1021				22,2673	43244 1	BPL	DAD	
1022	REF	1		22,2674	44700 0		SUHALFA	
1023	REF	3	LAST	400	22,2675	15330 0	DPHALF	
1024				22,2676	77650 1	GOTO		
1025	REF	1		22,2677	44702 1		CALCPHI	
1026				22,2700	77625 0	SUHALFA	DSU	
1027	REF	4	LAST	403	22,2701	15330 0	DPHALF	
1028				22,2702	77606 1	CALCPHI	PUSH	
1029				22,2703	57543 1	QKTHETA	DLOAD*	DCOMP
1030				22,2704	00013 0		10D,1	
1031				22,2705	87471 1	DOV	ARCSIN	
1032	REF	4	LAST	403	22,2706	00051 0	S1	
1033				22,2707	51123 0	PDDL*	BPL	PUSH DOWN PHI
1034				22,2710	00011 1		8D,1	
1035	REF	1		22,2711	44723 1		QKPHI	
1036				22,2712	57545 1	DLOAD	DCOMP	PUSH UP PHI
1037				22,2713	43244 1	BPL	DAD	
1038	REF	1		22,2714	44720 1		SUHALFAP	
1039	REF	5	LAST	403	22,2715	15330 0	DPHALF	
1040				22,2716	77650 1	GOTO		
1041	REF	1		22,2717	44724 0		VECOFANG	
1042				22,2720	52025 1	SUHALFAP	DSU	
1043	REF	6	LAST	403	22,2721	15330 0	GOTO	
1044	REF	2	LAST	403	22,2722	44724 0	DPHALF	
1045				22,2723	77745 1	QKPHI	DLOAD	PUSH UP PHI
1046				22,2724	43466 1	VECOFANG	VDEF	RVO



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 20211111-041

20'35 OCT. 28,1988 KOOLADE .089 PAGE 404

L ANGLPIND

USER=S PAGE NO. 13 E6 S4

P1047 ROUTINE FOR TERMINATING AUTOMATIC MANEUVERS

10512					22,2725	0	0004	0	NOGOM2	INHINT	
10513	REP	1			22,2728	0	3272	0		TC	ZEROERROR
10514					22,2727	0	0004	0	NOGO	INHINT	
10515	REP	4	LAST	253	22,2730	0	3245	1		TC	STOPRATE
A1052											
1053	REP	23	LAST	370	22,2731	3	4711	1		CAP	TWO
1054	REP	15	LAST	379	22,2732	0	5140	1		TC	WAITLIST
1055	REP	8	LAST	392	E8,1881					EBANK=	BCDU
1058	REP	1			22,2733		03237	1		2CADR	ENDMANU
1058	REP	1			22,2734		44108	0			
1058	REP	50	LAST	385	22,2735	1	5112	1		TCP	ENDOFJOB

THIS LOCATION ACCESSED BY A BZMF NOGO -2

TERMINATE MANEUVER
NOTE - ALL RETURNS ARE NOW MADE VIA
GOODEND



L GIMBAL LOCK AVOIDANCE

USER=3 PAGE NO. 1 E0 S4

```
0001      15,2000      BANK 15
0002 REF 3 LAST 400 22,2000 SETLOC KALOMAN1
0003      22,2736      BANK

0004 REF 9 LAST 404 E6,1681 EBANK= BCDU
R0005 DETECTING GIMBAL LOCK
0006 REF 1      22,2736 LOCKSKIRT EQUALS NOGIMLOC

0007      22,2736 77614 1 NOGIMLOC SET
0008 REF 1      22,2737 01074 0
0009      22,2740 70740 0 WCALC LXC,1 CALOMAN3
0010 REF 2 LAST 180 22,2741 01130 1 RATEINDX
0011 REF 1      22,2742 04772 1 ARATE,1
0012      22,2743 45002 1 SR4 CALL
0013 REF 3 LAST 388 22,2744 44530 1 DELCOMP

A0014
0015      22,2745 74343 0 DLOAD* VXSC
0016 REF 2 LAST 405 22,2746 04772 1 ARATE,1
0017 REF 48 LAST 402 22,2747 03343 0 COP
0018      22,2750 77721 0 MXV
0019 REF 1      22,2751 05004 0 QUADROT
0020 REF 1      22,2752 17311 1 STODL BRATE
0021 REF 4 LAST 393 22,2753 03385 1 AM
0022      22,2754 55805 1 DMP DDV*
0023 REF 1      22,2755 05002 0 ANGLTIME
0024 REF 3 LAST 405 22,2756 04772 1 ARATE,1
0025      22,2757 77661 0 SR
0026      22,2760 20808 0 S
0027 REF 1      22,2761 27317 1 STOVL TM
0028 REF 2 LAST 405 22,2762 03311 1 BRATE
0029      22,2763 77781 1 VXSC
0030 REF 1      22,2764 05026 0 BIASCALE
0031 REF 1      22,2765 03275 1 STORE BIASTEMP

A0032
0033      22,2766 77614 1 SETGO
0034 REF 1      22,2767 01035 0 CALOMAN2
0035 REF 1      22,2770 45033 0 NEWANGL +1
0036      22,2771 00044 1 ARATE 2DEC .0022222222
0037      22,2772 15053 0 2DEC .0088888889
0037      22,2774 24255 0 2DEC .0222222222
0038      22,2775 00554 0 2DEC .1777777777
0038      22,2776 02680 0 2DEC .000190735
0039      22,2777 05540 0 ANGLTIME 2DEC .000190735
0039      22,3000 26803 0
0040      22,3001 00003 1
0040      22,3002 04000 0
```

COMPUTE THE INCREMENTAL ROTATION MATRIX
DEL CORRESPONDING TO A 1 SEC ROTATION
ABOUT COP

ATTITUDE ERROR BIAS TO PREVENT OVERSHOOT
IN SYSTEM
STATE SWITCH CALOMAN2 (43D)
0(OFF) = BYPASS STARTING PROCEDURE
1(ON) = START MANEUVER
= .05 DEG/SEC

= .2 DEG/SEC

= .5 DEG/SEC

= 4 DEG/SEC

\$ 22.5 DEG/SEC

= 100R - 19

MANEUVER ANGLE TO MANEUVER TIME



L GIMBAL LOCK AVOIDANCE

USER'S PAGE NO. 2 E6 S4

0042	22,3003	03146 1	QUADROT	2DEC	.1	ROTATION MATRIX FROM S/C AXES TO CONTROL
0042	22,3004	14832 0				
0043	22,3005	00000 1		2DEC	0	AXES (X ROT = -7.25 DEG)
0043	22,3006	00000 1				
0044	22,3007	00000 1		2DEC	0	
0044	22,3010	00000 1				
0045	22,3011	00000 1		2DEC	0	
0045	22,3012	00000 1				
0046	22,3013	03131 1		2DEC	.099200	$= (.1) \cos 7.25$
0046	22,3014	11275 1				
0047	22,3015	77461 1		2DEC	-.012620	$= -(.1) \sin 7.25$
0047	22,3016	47370 0				
0048	22,3017	00000 1		2DEC	0	
0048	22,3020	00000 1				
0049	22,3021	00316 0		2DEC	.012620	$(.1) \sin 7.25$
0049	22,3022	30407 1				
0050	22,3023	03131 1		2DEC	.099200	$(.1) \cos 7.25$
0050	22,3024	11275 1				
0051	22,3025	00004 0	BIASCALE	2DEC	.0002543132	$= (450/180)(1/0.6)(1/16384)$
0051	22,3026	05253 0				



L KALCMANU STEERING

USER'S PAGE NO. 1 E0 S4

R0001 GENERATION OF STEERING COMMANDS FOR DIGITAL AUTOPILOT FREE FALL MANEUVERS

R0003 NEW COMMANDS WILL BE GENERATED EVERY ONE SECOND DURING THE MANEUVER

0004				15,2000			BANK	15	
0005	REP	4	LAST	405	22,2000		SETLOC	KALCMON1	
0006					22,3027		BANK		
0007	REP	10	LAST	405	E6,1661		EBANK=	BCDU	
0008	REP	4	LAST	400 TO 407	191 535*		COUNT	22/KALC	
0009	REP	2	LAST	393	22,3027	4 1332 0	NEWDELHI	CS	HOLDFLAG
0010					22,3030	0 0006 1		EXTEND	
0011	REP	2	LAST	393	22,3031	6 2725 0		BZMP	NOGO -2
0012	REP	12	LAST	392	22,3032	0 6006 1	NEWANGL	TC	INTPRET
0013					22,3033	75160 1		AXC,1	AXC,2
0014	REP	13	LAST	392	22,3034	03320 0		MIS	
0015	REP	12	LAST	402	22,3035	03425 1		DEL	
0016					22,3036	77624 1		CALL	
0017	REP	4	LAST	392	22,3037	44304 0		MM3	
0018					22,3040	45575 1		VLOAD	STADR
0019	REP	14	LAST	407	22,3041	50442 0		STOVL	MIS +12D
0020					22,3042	77626 0		STADR	
0021	REP	15	LAST	407	22,3043	50450 0		STOVL	MIS +6D
0022					22,3044	77626 0		STADR	
0023	REP	16	LAST	407	22,3045	74456 0		STORE	MIS
0024					22,3046	45160 1		AXC,1	CALL
0025	REP	17	LAST	407	22,3047	03320 0		MIS	
0026	REP	2	LAST	386	22,3050	44655 1		DMTOCDU	
0027					22,3051	77634 0		RTB	
0028	REP	2	LAST	386	22,3052	45547 0		V1STO2S	
0029	REP	1			22,3053	03267 1		STORE	NCDU
0030					22,3054	77414 0		BQCLR	EXIT
0031	REP	2	LAST	405	22,3055	01215 0		CALCMAN2	
0032	REP	1			22,3056	45142 1		MANUSTAT	
0033	REP	24	LAST	404	22,3057	3 4711 1		CAP	TWO
0034	REP	2	LAST	112	22,3060	55*664 0	INCRDCDU	TS	KSPNDX
0035					22,3061	6 0000 1		DOUBLE	
0036	REP	2	LAST	112	22,3062	55*665 1		TS	KDPNDX
0037	REP	3	LAST	407	22,3063	51*664 1		INDEX	KSPNDX
0038	REP	2	LAST	407	22,3064	3 1666 0		CA	NCDU
0039					22,3065	0 0006 1		EXTEND	
0040	REP	4	LAST	407	22,3066	5 1664 1		INDEX	KSPNDX
0041	REP	11	LAST	407	22,3067	21*661 0		MSU	BCDU
0042					22,3070	0 0006 1		EXTEND	
0043	REP	1			22,3071	7 3141 1		MP	DT/TAU
0044	REP	3	LAST	407	22,3072	51*665 0		INDEX	KDPNDX
0045	REP	2	LAST	107	22,3073	53*576 0		DXCH	DELCUX

SEE IF MANEUVER HAS BEEN INTERRUPTED
BY ASTRONAUT
IF SO, TERMINATE KALCMANU

COMPUTE THE NEW MATRIX FROM S/C TO
STABLE MEMBER AXES

CALCULATE NEW DESIRED CDU ANGLES

PICK UP THE NEW CDU ANGLES FROM MATRIX

NEW CDU ANGLES

TO START MANEUVER
+0 OTHERWISE

NEW DESIRED CDU ANGLES

INITIAL S/C ANGLE OR PREVIOUS DESIRED
CDU ANGLES

ANGLE INCREMENTS TO BE ADDED TO



L KALOMANU STEERING

USER=3 PAGE NO. 2 E6 34

0046	REF	5	LAST	407	22,3074	51*884 1	INDEX	KSPNDX
0047	REF	3	LAST	407	22,3075	3 1888 0	CA	NCDU
0048	REF	6	LAST	408	22,3076	51*884 1	INDEX	KSPNDX
0049	REF	12	LAST	407	22,3077	57*881 1	XCH	BCDU
0050	REF	4	LAST	407	22,3100	51*885 0	INDEX	KOPNDX
0051	REF	2	LAST	108	22,3101	55*848 0	TS	CDUXD
0052	REF	7	LAST	408	22,3102	11*884 0	CCS	KSPNDX
0053	REF	1			22,3103	1 3080 0	TCP	INCRCDU

DCDU EVERY TENTH SEC
BY LEM DAP

LOOP FOR THREE AXES

0054					22,3104	0 0003 1	RELINT	
R0055							COMPARE PRESENT TIME WITH TIME TO TERMINATE MANEUVER	
0056	REF	1			22,3105	0 3115 1	TMANUCHK	TC TIMECHK
0057	REF	1			22,3106	1 3208 1	TCP	CONTMANU
0058	REF	52	LAST	393	22,3107	3 4712 1	CAP	ONE
0060	REF	16	LAST	404	22,3110	0 5140 1	MANUSTAL	TC WAITLIST
0061	REF	13	LAST	408	E6,1881		EBANK=	BCDU
0062	REF	1			22,3111	03232 1	2CADR	MANUSTOP
0062	REF	1			22,3112	44108 0		
0063					22,3113	0 0003 1	RELINT	
0064	REF	51	LAST	404	22,3114	1 5112 1	TCP	ENDOFJOB
0065					22,3115	0 0008 1	TIMECHK	EXTEND
0066	REF	11	LAST	374	22,3118	4 0025 1	DCS	TIME2
0067	REF	1			22,3117	53*873 0	DxCH	TTEMP
0068					22,3120	0 0008 1	EXTEND	
0069	REF	2	LAST	405	22,3121	3 1717 1	DCA	TM
0070	REF	2	LAST	408	22,3122	21*873 0	DAS	TTEMP
0071	REF	3	LAST	408	22,3123	11*872 1	CCS	TTEMP
0072	REF	138	LAST	384	22,3124	0 0002 0	TC	0
0073					22,3125	1 3127 1	TCP	+2
0074	REF	1			22,3126	1 3137 0	TCP	2NDRETRN
0075	REF	4	LAST	408	22,3127	11*873 0	CCS	TTEMP +1
0076	REF	139	LAST	408	22,3130	0 0002 0	TC	0
0077	REF	1			22,3131	1 3133 1	TCP	MANUOFF
0078					22,3132	4 0000 0	COM	
0079	REF	1			22,3133	8 3205 0	MANUOFF	AD QNESEC +1
0080					22,3134	0 0008 1	EXTEND	
0081	REF	2	LAST	408	22,3135	8 3137 1	BZMP	2NDRETRN
0082	REF	140	LAST	408	22,3136	24 002 0	INCR	0
0083	REF	141	LAST	408	22,3137	24 002 0	2NDRETRN	INCR 0
0084	REF	142	LAST	408	22,3140	0 0002 0	TC	0
0085					22,3141	03148 1	DT/TAU	DEC .1
0086					22,3142	77778 1	MANUSTAT	EXIT
0087					22,3143	0 0008 1	EXTEND	
0088	REF	12	LAST	408	22,3144	3 0025 0	DCA	TIME2
0089	REF	3	LAST	408	22,3145	21*717 0	DAS	TM
0090					22,3146	0 0008 1	EXTEND	

INITIALIZATION ROUTINE
FOR AUTOMATIC MANEUVERS

TM+TO MANEUVER COMPLETION TIME

L KALOMANU STEERING

USER=3 PAGE NO. 3 E6 S4

0091	REP	2	LAST	408	22,3147	4 3205 1	DCS	ONESEC	
0092	REP	4	LAST	408	22,3150	21=717 0	DAS	TM	(TM-T0)-1
0093					22,3151	0 0004 0	INHINT		
0094	REP	53	LAST	408	22,3152	4 4712 0	CS	ONE	ENABLE AUTOPILOT TO PERFORM
0095	REP	3	LAST	407	22,3153	55=332 0	TS	HOLDFLAG	AUTOMATIC MANEUVERS
0096	REP	3	LAST	405	22,3154	4 1130 0	CS	RATEINDX	SEE IF MANEUVERING AT HIGH RATE
0097	REP	15	LAST	345	22,3155	6 6211 0	AD	SIX	
0098					22,3156	0 0006 1	EXTEND		
0099	REP	1			22,3157	6 3161 1	BZMF	HIGHGAIN	
0100					22,3160	1 3164 0	TCP	+4	
0101	REP	1			22,3161	4 1501 0	HIGHGAIN CS	RCSPLAGS	IF SO, SET HIGH RATE FLAG (BIT 15 OF
0102	REP	29	LAST	381	22,3162	7 4674 1	MASK	BIT15	RCSPLAGS)
0103	REP	2	LAST	409	22,3163	27=501 0	ADS	RCSPLAGS	
0104	REP	3	LAST	405	22,3164	53=711 0	DXCH	BRATE	X-AXIS MANEUVER RATE
0105	REP	6	LAST	173	22,3165	53=526 0	DXCH	WBODY	
0106	REP	4	LAST	409	22,3166	53=713 1	DXCH	BRATE +2	Y-AXIS MANEUVER RATE
0107	REP	1			22,3167	53=530 1	DXCH	WBODY1	
0108	REP	5	LAST	409	22,3170	53=715 1	DXCH	BRATE +4	Z-AXIS MANEUVER RATE
0109	REP	2	LAST	108	22,3171	53=532 0	DXCH	WBODY2	
0110	REP	2	LAST	405	22,3172	3 1675 1	CA	BIAS1	INSERT ATTITUDE ERROR BIASSES
0111	REP	2	LAST	107	22,3173	55=564 0	TS	BIAS	INTO AUTOPILOT
0112	REP	3	LAST	409	22,3174	3 1677 0	CA	BIAS1	
0113	REP	2	LAST	107	22,3175	55=565 1	TS	BIAS1	
0114	REP	4	LAST	409	22,3176	3 1701 0	CA	BIAS1	
0115	REP	2	LAST	107	22,3177	55=566 1	TS	BIAS2	
0116	REP	5	LAST	299	22,3200	3 0025 0	CA	TIME1	
0117	REP	3	LAST	409	22,3201	6 3205 0	AD	ONESEC +1	
0118	REP	1			22,3202	57=671 0	XCH	NEXTIME	
0119	REP	2	LAST	408	22,3203	1 3057 1	TCP	INCRDCDU -1	
0120					22,3204	00000 1	ONESEC	DEC	0
0121					22,3205	00144 0	DEC		100
0122					22,3208	0 0004 0	CONTMANU	INHINT	CONTINUE WITH UPDATE PROCESS
0123	REP	6	LAST	409	22,3207	4 0025 1	CS	TIME1	
0124	REP	2	LAST	409	22,3210	6 1671 0	AD	NEXTIME	
0125	REP	129	LAST	384	22,3211	10 000 0	CCS	A	
0126	REP	54	LAST	409	22,3212	6 4712 1	AD	ONE	
0127	REP	1			22,3213	1 3216 0	TCP	MANUCALL	
0128	REP	1			22,3214	6 4674 0	AD	NEXMAX	
0129					22,3215	4 0000 0	COM		
0130	REP	17	LAST	408	22,3216	0 5140 1	MANUCALL	TC	WAITLIST
0131	REP	14	LAST	408	E6,1661		ERANK=	BCDU	
0132	REP	1			22,3217	03225 1	ZCADR	UPDTCALL	
0132	REP	1			22,3220	44106 0			
0133					22,3221	0 0003 1	RELINT		
0134	REP	4	LAST	409	22,3222	3 3205 0	CAF	ONESEC +1	INCREMENT TIME FOR NEXT UPDATE
0135	REP	3	LAST	409	22,3223	27=671 1	ADS	NEXTIME	
0136	REP	52	LAST	408	22,3224	1 5112 1	TCP	ENDOFJOB	



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 2021111-041

20'35 OCT. 28, 1966 KOOLADE .069 PAGE 410

L KALOMANU STEERING

USER'S PAGE NO. 4 E6 S4

0137	REP	1		22,3225	3 7663 0	UPDCALL CAP	PRI026
0138	REP	14	LAST 373	22,3226	0 5042 1	TC	FINDVAC
0139	REP	15	LAST 409	E6,1661		EBANK=	BCDU
0140	REP	1		22,3227	03027 1	2CADR	NEDELHI
0140	REP	1		22,3230	44106 0		
0141	REP	16	LAST 380	22,3231	0 5213 1	TC	TASKOVER

CALL FOR UPDATE
OF STEERING COMMANDS

L KALOMANU STEERING

USER'S PAGE NO. 5 E8 S4

P0142 ROUTINE FOR TERMINATING AUTOMATIC MANEUVERS

0143	REP	1		22,3232	0 3258 0	MANUSTOP	TC	STOPYZ	
0144	REP	1		22,3233	0 3303 1		TC	LOADYZ	
0145	REP	6	LAST	392	22,3234	3 1155 1	ENDROLL	CA	CPHI
0146	REP	3	LAST	408	22,3235	55=848 0	TS	CDUXD	SET CDUXD TO THE COMMANDED OUTER GIMBAL
0149	REP	5	LAST	404	22,3236	0 3245 1	TC	STOPRATE	
0150	REP	1			22,3237	3 1327 0	ENDMANU	CA	ATTPRIO
0151	REP	2	LAST	198	22,3240	54 083 0	TS	NEWPRIO	RESTORE USERS PRIORITY
0152	REP	84	LAST	384	22,3241	3 4714 1	CA	ZERO	ZERO ATTCDR
0153	REP	3	LAST	188	22,3242	53=328 0	DXCH	ATTCDR	
0154	REP	2	LAST	198	22,3243	0 5053 1	TC	SPVAC	RETURN TO USER OF GOMANUR
0155	REP	17	LAST	410	22,3244	0 5213 1	TC	TASKOVER	
0156	REP	85	LAST	411	22,3245	3 4714 1	STOPRATE	CAP	ZERO
0157	REP	3	LAST	407	22,3246	55=575 0	TS	DELCUX	
0158	REP	4	LAST	411	22,3247	55=578 0	TS	DELCUX +1	ZERO ROLL INCREMENTAL ANGLES
0159	REP	7	LAST	409	22,3250	55=525 0	TS	WBODY	RATE
0160	REP	8	LAST	411	22,3251	55=528 0	TS	WBODY +1	
0161	REP	3	LAST	409	22,3252	55=564 0	TS	BIAS	BIAS
01611	REP	30	LAST	409	22,3253	4 4874 1	CS	BIT15	MAKE SURE HIGH RATE FLAG (BIT 15 OF
01612	REP	3	LAST	409	22,3254	7 1501 0	MASK	RCFLAGS	RCFLAGS) IS RESET.
01613	REP	4	LAST	411	22,3255	55=501 0	TS	RCFLAGS	
0162	REP	86	LAST	411	22,3258	3 4714 1	STOPYZ	CAP	ZERO
0163	REP	2	LAST	107	22,3257	55=577 1	TS	DELCUY	ZERO PITCH, YAW
0164	REP	3	LAST	411	22,3260	55=600 1	TS	DELCUY +1	INCREMENTAL ANGLES
0185	REP	2	LAST	107	22,3261	55=801 0	TS	DELCUZ	
0186	REP	3	LAST	411	22,3262	55=802 0	TS	DELCUZ +1	
0187	REP	2	LAST	409	22,3283	55=527 1	TS	WBODY1	RATES
0188	REP	3	LAST	411	22,3264	55=530 1	TS	WBODY1 +1	
0189	REP	3	LAST	409	22,3285	55=531 0	TS	WBODY2	
0170	REP	4	LAST	411	22,3268	55=532 0	TS	WBODY2 +1	
0171	REP	3	LAST	409	22,3267	55=565 1	TS	BIAS1	BIASES
0172	REP	3	LAST	409	22,3270	55=586 1	TS	BIAS2	
0173	REP	143	LAST	408	22,3271	0 0002 0	TC	0	
0174	REP	7	LAST	398	22,3272	3 0032 0	ZEROEROR	CA	CDUX
0175	REP	4	LAST	411	22,3273	55=646 0	TS	CDUXD	PICK UP CDUX ANGLES AND STORE IN
0176	REP	2	LAST	219	22,3274	3 0033 1	CA	CDUY	CDUX DESIRED
0177	REP	2	LAST	108	22,3275	55=650 1	TS	CDUYD	
0178	REP	6	LAST	398	22,3276	3 0034 0	CA	CDUZ	
0179	REP	2	LAST	108	22,3277	55=652 0	TS	CDUZD	
0180	REP	144	LAST	411	22,3300	0 0002 0	TC	0	



ASSEMBLE REVISION 249 OF AGC PROGRAM COLOSSUS BY NASA 20211111-041

20'35 OCT. 28,1966 KOOLADE .089 PAGE 412

L KALCMANU STEERING

USER=S PAGE NO. 6 E6 S4

0181	REP	7	LAST	411	22,3301	3 1155 1	LOADCDUD	CA	CPHI
0182	REP	5	LAST	411	22,3302	55=848 0		TS	CDUD
0183	REP	1			22,3303	3 1158 1	LOADYZ	CA	CHETA
0184	REP	3	LAST	411	22,3304	55=850 1		TS	CDUD
0185	REP	1			22,3305	3 1157 0		CA	CPSI
0186	REP	3	LAST	411	22,3306	55=852 0		TS	CDUD
0187	REP	145	LAST	411	22,3307	0 0002 0		TC	Q

STORE TERMINAL ANGLES INTO
COMMAND ANGLES